This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain articles, news items, reports, digests and other presentations, together with editors' comments The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

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Fracture Symposium

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Fractures of the Elbow

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I DO NOT need to speak to you about the importance of fractures of the elbow; all of you who handle them know what a problem they present—how much worry many of them are or can be, and how, in spite of the very best of care they sometimes do not turn out well. They constitute a very large group of fractures, representing about 10% of all skeletal injuries.

We can start in with the supracondyle fractures —these are the most common of the fractures at the elbow. But before we take up these fractures, I want to make one point very clear, and I think it is the most important point of all. It is that every fracture of the elbow must be considered in relation to injury of the soft structures in and about the bones. You must consider injury to the vessels and to the nerves. The only way to discover that is by examination of the hands. I see so many surgeons who will just look at the elbow, examine it, and then say: "Let's see the x-ray." They overlook the important point as to whether there has been nerve or circulatory damage. Many times there are serious complicating injuries in reference to the nerves and blood vessels, and if you don't discover them at the beginning there will be trouble. But, by all manner of means, look at the hand.

What can you discover by looking at the hand? First, in regard to circulation. You know, if the hand is pallid, and if you can't find the radial pulse, that arterial circulation is obstructed, and if this is serious there will almost invariably be loss of sensation and loss of motor power. And if there is a nerve injury you will find definite evidence of it. If it is a radial nerve you will have wrist drop, or if not that, you will only have loss of ability to complete the extension of the fingers; you will have characteristic loss of sensation over certain aspects of the thumb and the radial half of the index finger; if it is the ulnar nerve, you will have loss of sensation on the ulnar half of the ring finger and of the little finger; in median nerve injury you will have a loss of the finer movements of the thumb, and of the ability to oppose the thumb to the little finger — it can be put against the side of the index finger, but cannot be touched to the tip of the little finger. And there will be a curious loss of sensation over the end of the second, third, and fourth fingers. This loss of sensation will involve the volar aspects and a little of the dorsal of the fingers. These are all elementary things, but terribly important.

Now to come back to the fractures themselves, and particularly this supracondyle fracture. As you know, it is produced chiefly in children; you rarely see it in adults, but it may occur. It is almost always the result of a fall on the outstretched hand—the elbow is extended and you get the fracture down through the narrow part of the bone. There is always a narrowing of the bone in that place, and it makes a point of weakness where the fracture occurs, and the level of the fracture may vary somewhat. The displacement is always of the charactertistic type, with the distal fragment backward, and there is a certain amount of overriding of the fragments.

THE matter of reduction is important, and I want to show you how the common fracture should be reduced. Many times I see men go to work without stopping to think. They have an idea that all there is to do is just push it back. They don't get their reduction, though, and they

wonder why. Only about two days ago I had a child come in who had been treated the night previously at a hospital—not here, but in the country. It was a child of a prominent, well-to-do family, and I have no doubt they all tried to give her the best of care. She came in with this fracture—they had made a reduction under anesthetic, but the x-ray showed there had been no reduction of the deformity. Well, I had to go to work 24 hours after the injury, at a less favorable time, and attempt a closed reduction. We succeeded all right, but the reason was that we went at it in the right manner, whereas the man at the other hospital had not thought the thing out carefully. The fracture is produced by a fall on the outstretched hand. It is a known principle to repeat the steps by which the injury and displacement were caused, only, of course, in the reverse order.

Therefore, have the elbow in extension. And you want traction on the elbow, and you want an assistant pulling on the arm. It doesn't take trained help—you don't need trained help to pull on an arm. Place your hands on the front of the arm with both thumbs pressing on the lower end of the upper fragment and with the fingers reaching around posteriorally to grasp the lower fragment and olecranon. Press as hard as you can with the thumbs on the end of that fragment and lever the lower fragment forward — then, holding it, gradually bring the arm up into acute flexion. And when you do that the first thing you do is feel the pulse, and, if it is good, in all probability you have got the fracture reduced, because if it is out of place, flexing the elbow will also obstruct the radial pulse. You can do it if you want with the fluoroscope, but I can't see much through one. I prefer to have films made at the time, because there you have something objective, something that you can see. A lateral view will show it.

Then proceed to dress the elbow—put a little fold of thin cotton in the bend of the elbow and bandage the arm in the position of acute flexion. But supposing when you flex the elbow you find the radial pulse is stopped—which is apt to be the case if there is much swelling of the elbow—that would be because you are seeing the case late. If you are seeing it early there won't be much swelling of the elbow and you can then reduce the fracture easily. Of course, if you see it late, you may reduce the fracture, but it is hard to maintain it, because you don't dare put it up in the acute position. You will find the circulation is obstructed, so you have to content yourself with a less favorable position. You can't get the flexion, and then you will have to put on a posterior plaster shell in order to maintain that position of flexion.

Now you must check the radial pulse at frequent intervals for the first 24 hours. I also want to keep the patient over night at the hospital. I know I might get away with it 24 out of 25 times, but the one case I didn't get away with would haunt me to my dying day if an ischemic contracture resulted. I want to be able to feel the pulse every half hour, and I want to have the dressing cleared enough around the pulse so it can be felt.

A child was brought to me about 12 years ago, a small child who had fallen off a roof of a low shed two hours before admission to the hospital. The arm was tied to a straight board splint, no attempt having been made at reduction. I took off the splint and the first thing that struck me was how white the hand was. There was no pulse and the child could not move the fingers, couldn't even feel a pin sticking into the fingers. The x-ray showed a supracondyle fracture but with gross displacement. I was worried about the circulation, but felt that the first thing we ought to do was reduce the displacement. We gave an anesthetic, reduced the fracture and put the arm up at a right angle. I knew the condition was serious, and before I touched the patient I explained to the parents exactly what we were up against. I was therefore relieved of the responsibility of having produced that condition myself. I had discovered the condition beforehand.

Well, that child went on and developed a Volkman's ischemic contracture. I treated the child years afterwards. Whenever I got to feeling too good, that child would come back to my office and I would feel mighty humble again. I said to myself: "If ever I see this condition again, I will know what not to do."

So two or three years later we got another case—the child came in early with the same type of fracture and inability to move the fingers, and an absent radial pulse. With this case, we said, we will leave the fracture alone. We put the elbow on the pillow with the arm extended, gave heat to the arm and all manner of physiotherapy. We again got an ischemic contracture.

That was a discouraging thing. We had tried both methods, and a bad contracture had developed both times.

THE next case that came along we promised we would operate immediately. As a matter of fact we had a third case which came along a few years later. It wasn't my case, that is, I didn't treat it personally, but one of the surgeons on the fracture staff did, and I advised about it. He operated on the case immediately. It was exactly the same picture as in the other two cases. He made a medial incision over the region of the elbow and came down upon the lower end of the fragment protruding in the soft tissues and found the radial artery wound around this bone and then passed down underneath the other fragment. There was no pulsation in the artery whatever and the incision didn't bleed at the lower angle. When he lifted the artery off and cleared it, there was a return of pulsation and the whole circulatory condition changed.

That child made a complete recovery, without any of the former complications. Well, it was a

turning point, a historic moment so far as the surgeons of that hospital were concerned. We felt that we knew at least one cause of Volkman's ischemia. Now, since that time, I have heard of several other cases similarly treated—the findings have been different, however. In one case there was a complete solution of continuity of the artery. In another there was evidence of thrombosis in the artery. In a third case there was no definite injury found, but the artery was contracted down to small calibre and was pulsating feebly, perhaps an example of vaso-constriction due to sympathetic nerve stimulation.

But all of those cases have done better—they were not all 100% results, but the results were a lot better than in the first two cases treated without operation. So I want you to get this picture: that arterial interruption as shown by the signs I have described, is a signal you ought all to recognize as requiring immediate surgical intervention. The only procedure you can carry out is to expose the region of the fracture and the artery, and see its condition. If the artery is beyond repair, interrupted, or thrombosed, you cannot do anything, but at least you can remove the blood clot, and put in a drain for 24 to 48 hours, and that of itself will favor the establishment of a collateral circulation which we ought to get in most of these cases if the soft parts were not boggy with edema or extravasated blood.

I could go on indefinitely with this subject, but I have taken all my time on one fracture. After all, this is the most important of the elbow fractures and the one that confronts you frequently —the more special and complicated problems you probably wouldn't handle unless you had to, but the supracondylar fracture is one that you can't avoid.

Fractures of the Lower Leg and Ankle

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IN DISCUSSING the treatment of fractures of any part of the body, I think we have to keep in mind the fact that 90% of the treatment is to be estimated in terms of organization and equipment, and only 10% in terms of the man who is doing the work, no matter how good that man may be.

And the sooner we come to the realization of that fact, the sooner we come to realize that when new methods of treatment are advocated, they have to be evaluated in terms of the personnel, equipment and organization on hand to carry them out, the better off we are.

For that reason I am going to present for the lower leg fractures and the ankle fractures the methods of treatment now used and known, and I am going to attempt to evaluate those methods of treatment in terms of the organization, equipment and personnel which make any one of them at any one time the best method of treatment to use. It seems to me that is the only logical way in which to use methods of treatment. To use one method because George Washington or Abraham Lincoln proved it to be a wonderful method of treatment is an entirely wrong method of deciding whether it is to be used in any individual case. The theoretically worst method is often the best treatment, and I believe we get entirely too much into the bad habit of using the method which is advised as the best method of treatment for the injury involved. There is no best method of treatment for the injury involved.

I and my associates, at Presbyterian Hospital—when the ordinary "red" would be described as being merely "pink" — have many times been called "scarlet" in the ordinary treatment of fractures, in the open reduction of fractures. I feel, however, that that is under other conditions and even in our own hands, a treatment that is a dangerous thing. We are all of us consultants to various hospitals, and when asked to operate on a fracture at another hospital the answer is: No, unless it is unavoidable. I ask you to remember that I am talking now 10% in terms of the man who does the work and 90% in terms of what and with whom he is working.

I will start with fractures of the ankle. They are classified in many ways. Cotton had a wonderful classification based on ideological factors, but from the standpoint of treating a fracture, such evaluation is not worth a damn (the damn can be off the record). For those who have to treat fractures, the only method of tabulating or listing fractures of the ankle which is of any practical value is a classification that has therapeutic implications as to prognosis and as to possible end-results. If there is such a classification, it is of a great deal of help. I believe there is such a classification, and I'll tell you what I think it is.

Ankle fractures can be classified as follows:

The first group represents the easiest group to treat with the shortest disability time, and with the most certainty of success.

THE first type of fracture is a lineal fracture of the external malleolus. There is no reduction needed. The pathology is soft-part pathology, which has a great deal to do with future functioning. Splinting can be intermittent, and allow of soft-part pathology; no immobilization is needed, except the posterior lower splint, and ankle exercise can be allowed six or eight times a day for five-minute periods, with the use, also, of hot soaks. The total period of soakage necessary is 10 days. Then strapping of the ankle or the wearing of a skating ankle brace, the kind containing whalebone supports on the sides, for a period of two to three weeks thereafter. Full weight-bearing can be allowed with crutches in three weeks, and without crutches in about four weeks; and the total disability time should not run beyond six weeks.

This is commonly known as the Pott's fracture, but, as you know, the Pott's fracture is a serious fracture and requires prolonged immobilization;

is of a poor prognosis, in general, and has a longer disability time. Many of these cases are treated precisely as a Pott's fracture is treated. I have seen such a case demonstrated where a man was walking at the end of four weeks, in a walking cast, and the case was described as a radical treatment. And that wasn't in any outlying town, either, but right here in New York City—and there isn't a city in the United States where I haven't seen the same thing done.

THE second type of case is the same type, in which, in this sort of story, one has actual separation with, however, the bony portion of the malleolus on the inside, and remaining attached to the tibia, with the malleolus displaced laterally. It does require reduction and carrying of the astragalus back by direct lateral pressure to its normal position beneath the tibia, and it does mean the splint can not be removed for three weeks.

The disability time of the patient is no longer than that of the patient who has not had the separation, but his splints cannot be removed—for exercise and the hot soaks and the physiotherapy aids, in the early phase—not until the end of three weeks, instead of intermittently, at the end of 48 hours, as in the previous case. Whatever significance this fracture has, then, in terms of disability is in terms of swelling of the leg when the patient gets up and around, and, as I hope to show you, that is a thing easily controlled, if it is realized that it is a disability which may persist for some time.

Now, as opposed to these two groups, there are the internal malleoli fractures. They occur both with and without separation.

When they occur without separation the story is precisely that of the fractures of the external malleolus without separation—splinting up to 48 hours, intermittent splinting time of 10 days to two weeks, a total splinting time of three weeks, and weight-bearing at the end of that time, with crutches, and full weight-bearing with ankle braces thereafter, with a total disability time of roughly six weeks.

When the fracture is separated, one of two things happens.

If it should be a transverse fracture, with separation, tilting of the astragalus may occur. The reduction of these fractures is by manual replacement of the astragalus in its normal position and manual replacement of the malleolus. I should like to plead strongly against the idea that rotations of the foot into everse or inverse positions have anything to do with the replacement of the malleolus fractures. The idea that rotation into eversion or inversion has anything to do with replacement is an erroneous idea and leads to lack of replacement. These fractures must be manually placed and pushed into position with the fingers. No ankle fracture—and I say this without fear of contradiction—should be put up in plaster after reduction in any further inversion than the normal weight-bearing position of the foot. I think we must get out of our heads the idea that sharply everting or inverting a fracture does anything but further displace the malleolus fragments.

The transverse fractures show almost 100% delayed union and 40% non-union, if followed long enough. However, I have never yet seen a non-union of the internal malleolus which resulted in disability. I have never seen a delayed union of the tibial malleolus alone, as an isolated fracture, which has delayed progress of treatment. I stress that strongly because the average time in which the splints are taken off these malleolus cases depends on the x-ray findings of union or non-union—and it is a mistake. You have to treat the malleolus cases despite the x-ray picture.

I am reminded of Dr. Brewster, who used to be Head of the Surgical Service at the Massachusetts Hospital. I went up there as a young intern. Dr. Marble was House Surgeon. X-rays were then taken on heavy glass plates. At one time, in making the rounds with Dr. Brewster we came to a case of fracture of the bones of both legs. We were pretty proud of x-rays in those days. Dr. Brewster asked how many days the patient had been in splints, and when told he said: "Discard the splints." Henry Marble had been walking along with us, and when he heard that he looked up with a grin on his face and pulled the plates out and said: "The x-ray says he hasn't any union." Dr. Brewster said: "What?" and took the plates, looked at them, then looked at Henry, and scaled the plates against the wall saying: "The Hell with the x-ray; let him walk on crutches."

There is no place in which x-rays are less valuable than in fractures of the internal malleolus. Now I don't intend that to be construed by any means as belittling the value of x-rays in fracture treatment. Far from it—the x-ray is one of the most valuable adjuncts. But here is the exception that proves the rule—here is the place you cannot depend on it. In fact, you have to act in spite of it.

Where the fracture is oblique, in these cases, they heal practically 100% by bony union. The transverse fractures have non-union so frequently because of the fact that they are fractures caused by eversion of the foot, and, as this is torn off, the frayed periosteum and ligaments are pulled out, and when you replace the malleolus they are interposed.

In either of these cases the important thing is to replace that malleolus and splint it, and in either of these cases where the inner or external malleolus has separation, we have to add to the posterior molded splint a lateral splint of some sort. It doesn't make any difference what type of splint you use any more than does the color of the antiseptic you put on skin—it is just doing something. You can use the Stimpson device or the sugar tongs—merely a splint starting below the knee, under the instep, and coming up on the other side. But no single malleolar fracture needs to be splinted above the knee.

These internal fractures are treated precisely the same as the external fractures, the only difference being that the healing time is slower, and it is because you have to depend on fibrous union to bear strain that the weight-bearing story is delayed. The weight-bearing is delayed to four weeks

with crutches, and the disability time runs roughly between 10 and 12 weeks. That is not because of anything different in the fractures, but because when you start weight-bearing you are depending on a fibrous union, which cannot be depended on as soon as a bony union to bear the strain.

THE third group is the bi-malleolar fracture. By that I mean fractures of both malleoli, with separation, and not complicated by either disruption of the joint or posterior lip fracture. The presence of the latter puts an entirely different complexion on any of these cases. These present the worst deformities of any of the ankle fractures. I might say the bi-malleolar fractures, if seen early, are the easiest to reduce, because of the extensive amount of soft-part tearing which occurs, allowing treatment of the fracture. In the early days of the Presbyterian Hospital service, 10 years ago, we called the students in to the Admitting Department to see how this was reduced; we took them in and went through all the reductions in the foot displacements. First there was over-riding—we had to have down-riding traction; lateral displacement—we had to replace the astragalus by lateral compression underneath the tibia, and then we had to put the two malleoli in place. In one instance we saw the case within 20 minutes, and thereby hangs an important tale. We gave the patient an anesthetic and we said: "This traction should be kept up until you feel the foot come down." In 30 seconds there was a plop, and the only difference was that that was angulated on the main fragment of the tibia. That was reduced for two reasons: there was extensive tearing, and traction had more effect—which is true of almost all bi-malleolar fractures; and second, we didn't have to fight the calf muscles.

But there is one common factor—the difficulty of your reduction may be tremendously complicated if you ignore the time factor. And, the difficulty of your reduction may be complicated unless you make it with the completely flexed knee in order to replace it, replace the calf muscles. Such a fracture with traction and the leg straight may be difficult to reduce. One hears of cutting the tendon Achilles. I don't know how many of these fractures I have seen—and a great many of these men are better than I am, maybe, but I never had to cut that tendon yet. And you won't, if you practice reduction with the fully flexed knee.

Once these fractures are reduced they require all of three weeks in plaster—the immobilization time for the one which has the worst prognosis, internal malleolus. They require the weight-bearing delay which that calls for, which is six weeks, and the disability time is similarly handicapped.

Now where does the prognostic threat lie? It lies in the fact that the soft-part tearing is extensive. They get infiltration of the tissues by hemorrhage, inflammatory exudate, so that they form a tissue tourniquet of scar tissue, and the ankle swells and becomes painful and the patient has to take his shoes off, and there is the time for additional treatment which is circulatory treatment, and you have to keep them immobilized for three weeks. But you can minimize these difficulties if you recognize them, because of the swelling in these bi-malleolar cases, which is due to the lymphatic disturbance caused by the healing process. You can't do anything final about that, but what you can do is give the part the lymphatic support it should have until such time as the usual time for these adjustments to take place, particularly for this group and to the final group which I am going to take up, the so-called Pott's fracture.

ACADEMICALLY, I don't give a hoot whether Pott's described first a fracture with this or that—I am describing what we call a Pott's fracture because it is a separate group of cases which has a definite clinical import.

Let me use an Irishman's bull: The fact of importance in a so-called Pott's fracture is the ligamentous disruption of the tibia and fibula joint, widening of the mortice and, *ipso facto*, unstable astragalus. It results in the turning ankle, traumatic arthritis; it results in the so-called "swelling" leg which persists whenever a man tries to work. And nothing does any good unless that fracture of the disrupting of the joint with the widening of the mortice has not only been corrected but maintained correct, before and after weight-bearing, until not the bone will stand weight-bearing, but until a tissue strong enough to stand weight-bearing has been formed. It was a great puzzle, in following these cases up, until the important fact was caught on to, to find a beautiful reduction at the time the patient was hurt, and have the patient come back a year later complaining of the fact that his ankle turns over and swells and hurts, and the calf muscles are stiff and painful, and you take an x-ray and again find you have a widening mortice. But it is simply because we have not realized the stretching factor. You have got to protect that joint and keep the tibia and fibula together until it can stand that strain. That is why the Pott's fracture is so serious.

The fractures that come with the Pott's fracture are of no importance except one which is a complicated fracture, where the internal malleolus is frequently broken off; or the external malleolus may be occasionally gone; or neither malleolus may be gone but may be two or three inches above the interior-exterior fibula joint without angulation at that point. But the important thing is the disruption of the joint. In those fractures, the classical ones, the whole astragalus is carried laterally—it is also allowed to go posteriorally. It rides up behind the tibia—but the important thing is to get it under that. Now the manipulations necessary in this are the manipulations necessary to reduce whatever deformity is present. This is handled directly, and through the foot as a whole: not by inverting but by using the foot as a lever, carry it without inversion while you push out over the leg; completely flex the knee downward; push up on the heel and back on the tibia until you feel the foot come forward; then when it is forward, push in on the tibia and out. When you feel the

contact, hold it that way and you can take the other finger and get it where it belongs.

Now here comes the joker in this story: You have to do the splinting so that the gripping motion which keeps the two held together, never lets go.

Anyone who lets go of that before the plaster is hard is going to allow the joint to displace immediately. The plaster is still soft, remember. Don't think moral suasion is going to hold the surfaces together. It won't.

In a certain percentage of these you can't reduce the disruption of the mortice, and you can't reduce it because the ligamentous structures have been torn out of the bone and have dropped between the tibia and fibula, and you have a permanently widened mortice.

Those cases require operative treatment—even for those people who do not think it is right to operate on fractures!

That clinical test, though, is a very worth while thing to know, because if you operate on the fracture in its fresh condition, with its structures all intact, you are dealing then with a relatively simple proposition; not, however, if you operate a year later, or two years later, because of the persistent symptoms I have described. So, as I say, the clinical tests are very worth while.

Either the bi-malleolar or the Pott's type or external malleolar with separation may be complicated with one or two other fractures. The upward displacement or the backward drop is frequently not great, and unless you look for it you will not see it; yet if you do not replace it, you have a patient constantly falling forward on his foot. It is the astragalus coming back. It induces the symptoms of chronic weak feet, and when the posterior lip fragment is fractured, it has to be pulled down in position. The foot must not only be pulled down, but also must be pushed completely forward, and held there.

When the posterior lip is present, on the malleolar fractures, it complicates the story from the standpoint of weight bearing, and you again have the painful ankle. It complicates the malleolar fractures by allowing them not to bear weight before eight weeks, and, *ipso facto*, too, it conplicates the convalescence.

The other fracture is the anterior lip. That is a headache! The anterior lip ligaments are rudimentary; they are thin, and the tendons which run across it and the ligaments which run underneath are overlong to allow free play in the ankle joint, and it is the toughest job in the world to pull down an anterior lip. It requires two things: heel traction plus maintenance of the foot in the plantarflex position until that fragment is held in place. Maintaining the foot in that position allows the tendon Achilles to shorten. Both of these types of fracture have to be immobilized above the knee, with the necessary inflexion—as near a right angle as you can get it—and that knee immobilization has to persist for at least three weeks, until the fear of torsional strain producing displacement is gone.

THERE are men in this room with all sorts of experience with fractures; there are men here with all sorts of operative experience, from little to lots, and with all sorts of assistants. Some of them you have to use, and you wish to God you didn't! There are men in this room who have all sorts of hospitals to work with.

The point that I am trying to make about operative treatment is this: If you have the facilities, the equipment, the personnel, in the way of trained assistants and nursing assistants, and if you have a nursing staff so trained that they can check on everything post-operative—many of these ankle fractures are best treated by immediate reduction —that is 90%, and 10% is the man himself.

Let's take the Pott's fracture, for example: Under methods of conservative treatment that patient, after having gone through reduction, has to be immobilized above the knee for an additional five weeks, before even actual movement can be allowed at the ankle joint—otherwise those ligaments will spread. He can't assume full weight bearing, certainly, with safety, before a minimum of 12 weeks, and usually 16 weeks, that is, if you don't want a swelling leg. That is four months; and then he has got to get used to weight bearing, making the disability time approximately six months on the average. I say "on the average," but it is a lot longer in many cases. [At this point Dr. Murray described by diagram, an operative method, using bolts and plate.]

Such a case is splinted by posterior molded splint for 48 hours. It is then on there intermittently—intermittent splinting—and every hour on the hour it is given active exercise, preferably under water. Such a patient is walking on crutches in about two weeks.

A typical example of such a case was of a woman who weighed 180 pounds. She was a filing clerk on Wall Street. She lived on Washington Heights. We operated on her and she was out of the hospital in two weeks. When she went back to work on Wall Street she had to travel in the rush hours in the subway, where as you know, the men sit down and the women stand up, and she was no exception. She made that trip twice a day exactly eight weeks after the operation, at a time when the other way she would still be on crutches, without weight bearing, that is by closed methods.

Now, I don't care what you think about operative treatment—you can't laugh that off! And if you can repeat it again and again it gets harder to laugh off every time it is done. If you ask me am I telling you to do it?—Hell no! But I am going to make a plea to you.

I will make this statement to every man in this room: If you will get your hospital or whoever it is that controls your hospital, to equip and man that hospital as it should be equipped and manned, you won't have to stop and say: "We can't do advanced treatment in fractures."

It is 10% of it the man. Any man in this room with good surgical equipment can do exactly the same thing, and if he tries it without good surgical equipment, even if he be the most expert bone

surgeon in the world, and says so, he can't do it.

Now, the only way we will ever get that is by preaching—getting warts on our vocal chords by talking of it; by men connected with the hospitals getting an inch here and a millimeter there—and maybe not so that *you* can do it, but so that the men coming after you, 20 or 30 years after you, can do it. That is the important thing. It is not a question in the fracture treatment story, what you and I can do. It is a question what your hospitals are going to do in the way of maintaining equipment 20 or 30 years from now. If it is not done they are never going to advance, and a man is going to be just as handicapped as you are today.

One other point about the ankle fractures is the occasional fracture one sees with comminution of the lower tibia, where there is the bone split into a million fragments by reason of a high fall. They are difficult to pull down into position. Some form of skeletal traction is essential. Operative treatment is out of the question. The treatment will have to be by traction, one pin pulling down and another up through the os calcis; and, when adequate reduction is obtained, they may be put in a plaster cast in which wires are incorporated, otherwise they will shorten up.

As I have said, frequently the disability is due not to the fracture but to the swelling in the leg, stiffness in the calf muscles and pain in the ankle—that is, when the patient has been working for any time, and it swells. More than half, and my own feeling is 75%, of these disabilities would be wiped out, assuming that all other factors in the cases were adequately handled, if two things were done:

Not to assume but to realize that by immobilization of a leg for six or more weeks, you have *ipso facto* made a present to that man of the weak foot, whether he had it or not. And if you do not recognize it and do not do more than philosophize about it, he is going to have the symptoms of it, and it is a present from you to him so that he won't forget you—and he doesn't. All of those patients ought to have a lift on the inside of the shoe, and be taught the walking and sitting posture of toeing in, and whatever else you believe the best treatment. And such a patient has to have this treatment for weak foot from the moment he bears weight on it.

Secondly, every case, particularly the bi-malleolar and Pott's fracture, should wear Ace bandages or an Unna's paste boot, but preferably an elastic stocking for a year or more from the time of first putting the leg down. You don't have to give phyiotherapy to correct swelling — you don't let it happen.

There is one more plea: You are all industrial surgeons and you all think in terms of hospitalization. You say: "How long in the hospital?" You are inclined to use the job that cuts down hospitalization. Let me say that that is damned false economy—by not prolonging the hospital disability so that they have elevation, have the stimulation of the muscles, and the exercise every hour on the hour, supervised by nurses, who, every time they comb his hair give him the exercises.

I don't ask you to believe me—try it on your own cases. Forget the hospitalization story for a while and think in terms of total disability—in terms of end results, and you will find that a little less howling about how long a man is going to be hospitalized is a worth while consideration.

Fracture of the Femur Shaft

Robert H. Kennedy, M.D.,
Surgeon-in-Chief, Beekman Street Hospital, New York City

FRACTURE of the shaft of the femur is a common, severe injury, frequently resulting in death, permanent disability or prolonged invalidism.

Before the War of 1914-1918, the usual handling of these patients consisted of reduction under anesthesia followed by immobilization by plaster encasement. Sporadic attempts had been made to introduce traction in the form of Buck's extension or insertion of a Steinman pin, and also open reduction with internal fixation. None of these methods made much progress, and reduction and plaster encasement continued to be the routine treatment. This was difficult to carry out in compound fractures and, in all types, resulted in shortened limbs, poor weight bearing axes, and loss of joint function with appalling regularity.

At the commencement of the War, application of a plaster encasement or internal fixation of fragments was the common procedure in compound fractures of the femur. It soon became evident that the results of either method were too unsatisfactory to continue their use. Traction methods became popular, at first by pull on the skin and later by pull upon the distal fragment of bone.

On returning to civil practice many surgeons reverted to the plaster encasement of both simple and compound fractures, but the majority of those with a particular interest in fractures continued to use some form of traction. The latter believed that the original length, proper axis and complete function were to be desired in every case, and that these results were difficult to obtain following immobilization by a plaster bandage. Therefore, ice tongs or Steinmann pins came into common use for skeletal traction. About 1920 the Kirschner wire began to be used instead of these and proved a real advance in the technic of skeletal traction.

Meantime open reduction, which had been on the wane for some years on account of numerous infections followed by osteomyelitis, again began to rise in popularity.

About 1930 the Russell method of balanced traction, described some years before, became more generally known in this country.

By 1935 the double-pin method of traction, followed by plaster immobilization and ambulatory care, was being undertaken.

With all these possible methods, what are the indications for our treatment of an individual patient?

EXCEPT in severe hemorrhage and cessation of breathing there is no accident in which proper first aid care and transportation is of greater importance than in fractures of the lower extremity. We believe that the application of fixed traction at the site of accident, with its continuance in transportation both to and in the hospital, is a major factor in the treatment of fractures of the shaft of the femur. Its use affects the chances of life, of saving the limb, of obtaining good reduction, and of prolongation of the stay in a hospital. As physicians it is our duty to see that in our communities the opportunity is made available to every such injured person to have fixed traction applied at the site of accident. This usually means that laymen must be trained in the application. At the present time the medical profession is more indifferent to this feature than is the lay public.

The next factor in treatment is immediate care. This means that it must be possible in a hospital to make an x-ray film or a fluoroscopic examination any time in the 24 hours. It means that surgeons have to get up at night to see patients with fractures. It means that in compound fractures immediate emergency operation is vital. It is of more importance that the physician shall see to it that the patient obtains all of the foregoing than that he shall know all about the various methods of reduction, immobilization and after care. What is the advantage of knowing how to put up skeletal traction in a compound fracture if the debridement is delayed beyond the optimum time, infection sets in, and the extremity has to be amputated?

THERE are many early deaths in fractures of the femur. Perhaps some of these may be saved by transportation in traction, early attention to shock, etc., but it remains true that the accident causing this fracture is usually a severe one, often resulting in multiple injuries, adding up to a total too great for an individual to combat successfully. In a recent review of 120 fractures of the shaft of the femur treated at the Beekman Street Hospital there were 17 early deaths. Fourteen of them had multiple, severe injuries of which the femoral fracture formed only a part. One died within 48 hours, of alcoholism and delirium tremens. One died within 24 hours of cerebral embolism. The remaining patient had a severe compound comminuted fracture of the lower third, with severe hemorrhage. His condition was such that only packing of the wound was feasible the first day. A debridement was effected on the second day and an amputation through the site of fracture on the fourth day, on account of gangrene of the leg from disturbance of the blood supply. The patient died on the sixth day. Fourteen of the 17 patients died within 24 hours, in spite of their being in a hospital, where the ambulances bring them in in fixed traction and where the emergency nature of the service calls for the immediate institution of shock treatment. It is truly an injury where first aid and skilled hospital attention are always called for.

We believe that open operative reduction with internal fixation is the method of choice with an ideal patient, ideal operating team, and ideal operating room set-up. Anatomically the fragments can be returned to nearer normal position with original length and proper axis much more surely. With internal fixation mobilization can be instituted sooner, and early weight bearing is made safer with this internal splinting. But in the great majority of instances ideal conditions do not exist. It is obvious that there are many injured who cannot be put in condition, even within the first seven to 10 days, so that an open reduction would be justified. Facility in open reduction is not obtained when the experience is perhaps a half dozen cases a year. No matter how experienced the operator himself, this is a team job, and the resultant may be no better than the weakest link in the team. No one does an open reduction happily in an operating room which is habitually used for opening abscesses, peritonitis and empyema cases, etc. Theoretically it is all right, but you and I have qualms when we have to do it. Changing interne and nursing staffs add greatly to the hazard unless there is sufficient bulk of this type of work so that all are always experienced. It has been stated that if surgeons were sufficiently interested they could insist that all hospitals should be properly equipped and the staff duly organized to make this work safe. Again theoretically true, but often impractical. For instance, in the Beekman Street Hospital, from which I reported these cases, there are 100 beds and about 300 hospitalized fractures a year. Not over 50 of these could possibly be benefited by open reduction and internal fixation. We have one operating room for all types of cases, including several gas bacillus cases each year.

For these reasons we have not made open reduction the method of choice, but have employed it only when other methods have proved ineffective. We believe similar situations exist in many other hospitals, and that all the other types of treatment need to be known and evaluated—since any one of them may be the best method for an individual patient under certain conditions.

We believe that plaster encasement following closed reduction is only rarely of value at any age. Slipping of the fragments occurs frequently while plaster is being applied. If the position is maintained early, slipping commonly occurs later, due to the shrinkage of the bulk of the extremity from lack of use and to bone absorption at the fracture site. Plaster encasement was the best we had for a long time, but this is no longer true.

There are many methods of traction, some good and some useless. Bilateral overhead adhesive plaster traction is the method of choice for children under six years of age. Closed reduction under complete anesthesia should often accompany this method. Except for interposed muscle, I can imagine no indication for open reduction in simple fractures in these children.

Buck's extension, adhesive plaster traction in Thomas splint suspension, and other methods of straight skin pull through adhesive plaster should be discarded, as we have better methods. Too often overriding was never overcome, or, if it was, the adhesive plaster slipped and the overriding re-

curred. When the adhesive came away the skin often came with it, making reapplication impossible for some time. In general twice as much pull is required for skin traction as skeletal traction. Rarely will skin stand as much as 20 pounds traction for any length of time. This is equivalent to 10 pounds skeletal traction which is seldom enough to overcome overriding, or prevent it from recurring, in these fractures. Skin traction in this form should be relegated to the historical museum.

Skeletal traction has given us excellent service. Overriding can almost invariably be overcome. Angulation or rotation can be corrected by changing the position of the joints, by varying the direction of the pull, or by pressure pads. A certain amount of mobility of the knee can be preserved throughout if the skeletal application is in the femur and not in the tibia. The thigh is exposed for dressing or physical therapy without disturbing traction or position. Again, to obtain uniformly good results a trained team is required, including house staff, nurses, and orderlies. There is little use in the visiting surgeon seeing that the set-up is proper on rounds and an hour later having a rope caught in a pulley and no one trained to keep watch of it, or to know that anything is wrong, or how to fix it if they know it. Another difficulty is distraction, or overpull, which has been so well discussed by Blum, of this hospital. Whenever it occurs it is a serious indictment of traction, for it causes markedly delayed union. We have not seen it result in non-union.

INFECTION has been a serious complication of skeletal traction. In this regard we must compare it with open reduction. So far as the patient is concerned it makes little difference in his happiness whether an osteomyelitis is at the site of fracture or at the site of insertion of tongs or Steinmann pin. If you tell me that you do not get these infections, I shall have to doubt that you follow up your patients. In 42 of our patients with skeletal traction by tongs or pin we had 21 who showed evidence of infection at some time. Two-thirds of these healed promptly after removal of the tongs or pin and remained healed. The other seven, or 17%, of the total, discharged for a long enough period so that we must consider that infection of the bone was present. Since we have been using the Kirschner wire we have found that superficial soft part infections are even more common, but that bone involvement is rare. I believe there is little excuse for using ice tongs or large Steinmann pins any longer, since we have Kirschner wire and small pins. Reduction under anesthesia is usually needed with skeletal traction treatment.

Balanced traction by the Russell method should be known to all. With thigh and knee in about 20° flexion, pull is exerted through a double pulley system. Adhesive plaster is applied to the skin from the knee down. The weight applied is only one half that required for skeletal and one-quarter that required for skin traction, so that difficulties with adhesive pulling off seldom occur. The thigh is exposed for dressing and physical therapy. The patient is comfortable, and nurses say that nursing care is simpler than with any other form of traction or with plaster. Once set up there is less to get out of order as regards the apparatus than is the case with other forms of traction. The resultant mobility of joints is better than any other method I know of. Reduction under anesthesia is commonly needed in addition. There are no operative wounds to be considered. Overpull is a definite danger.

I have had no experience with treatment in the Hodgen's splint, although I saw it in extensive use in a St. Louis hospital within the past four years with results said to be satisfactory. Neither have I tried the double-pin plaster immobilization ambulatory method, although I have seen excellent results in its use.

In regard to compound fractures, first aid, fixed traction transportation and necessity of emergency hospital care are the same. Debridement is required. In general, primary closure should not be done. Excellent results are being obtained in some outstanding clinics by immediate internal fixation and leaving the wound open. This is usually followed by Dakinization or some similar wound treatment. I have had no personal experience with this method. I believe it is excellent treatment, but should be carried out only in those institutions where the set-up is such that open reduction with internal fixation is the usual treatment for simple fractures. In other places one of the methods of traction described above should be used. Generally I have more confidence in using skeletal traction than Russell traction.

All of these patients use walking caliper splints hinged at the knee for several months after they are allowed out of bed.

Omitting fractures near the joints, the treatment varies somewhat according to the third of the femur involved. In the Beekman Street Hospital our preferred treatment at present in fractures of the upper third of the shaft, except in children under six years, is first Russell traction and second skeletal traction by Kirschner wire inserted just above the condyles of the femur.

In oblique fractures of the middle third our preferred treatment is the same as in the upper third. Long oblique fractures or marked comminution are frequent here so that we believe, whatever the set-up, internal fixation is often contra-indicated because of the amount of exposure and of hardware required.

In transverse fractures of the middle third we believe internal fixation should be effected, unless distinctly contra-indicated. It is difficult to obtain the desired apposition by any traction method, and overpull is all too common. Complete immobilization is necessary for union to occur promptly.

In the lower third of the shaft we are not satisfied with our results by traction methods. Here, too, we believe internal fixation should be used, unless distinctly contra-indicated. If this is the case, we favor skeletal traction by Kirschner wire through the lower end of the femur with sometimes an additional wire through the tubercle of the tibia. The latter is then used for distraction and the former to overcome the posterior angula-

tion. Our results have not warranted the continuation of the use of Russell traction for this region.

The results obtained after fracture of the shaft of the femur should be much improved by more thoughtful handling and centralized hospital control.

The Role of the Railroad Surgeon

—*In Improving the Standards of the Treatment of Fractures*—

FREDERIC W. BANCROFT, M.D.,
New York City

MY RELATIONS with railroad surgeons go back a long time. My father was the first surgeon to put the first aid kit in a railroad train, and one of the first to establish a railroad hospital.

The railroad surgeon has come a long way in the last 10 years. I can remember when a committee of railroad surgeons met with the American College of Surgeons' Fracture Committee. That was about 10 years ago, and then there was a attitude of frustration in their idea of attempting to improve treatment of railroad cases. I remember we suggested the use of the Thomas splint at that time, and they felt that that was an impossibility, that the claim agent couldn't be persuaded of the necessity of such a thing, and that it was altogether an impossible procedure. So you see, you have come a long way. Dr. Kennedy's preachment of the first aid methods has borne fruit with your company, and now, automatically, every member of the railroad surgeons is a member of the Regional Fracture Group of the College, because your group is a group of the College, and it is Dr. Scudder's great desire to have the thousands of railroad surgeons throughout the country become a definite regional group. You thereby come into an educational problem and an educational advantage and stimulus that you can carry along, not only in your railroad work but also in your home towns.

I wrote to Dr. Webb, Chief Surgeon of the Great Northern, when I suddenly became conscious I was due for a paper in such a very short time, and didn't know what to say, and I asked him: "What can the railroad surgeon do?" I would like to quote, briefly, from his reply:

"I think that the railroad surgeon's role in improving the treatment of fractures is to first get his community active on the first aid problem. I am enclosing a copy of the Grand Folks, North Dakota, ordinance which was put over by one of the Great Northern surgeons. This has been done in several of our communities by the railroad surgeons.

"I am also enclosing a copy of a book of first aid instructions recently gotten out by the Association of American Railroads. The railroad surgeons can use this material in the instruction of employees and others. These books are being distributed to the railroad surgeons and to the employees all over the United States."

The ordinance referred to by Dr. Webb reads as follows: *

"In an editorial published in the *Journal-Lancet*, January 1, 1936, the Chicago Ambulance and Fracture ordinance was printed. The editorial suggested that this ordinance should be shown to city officials with the hope that other cities might adopt a similar regulation for the protection of citizens who may receive fractures. Recently the Board of City Commissioners of Grand Forks, North Dakota, approved and adopted the following regulation:

"Public Health Regulation No. 525: The Board of Health judge it necessary for the public health and safety of inhabitants to prevent further damage to an injured person after an accident.

"No person, firm or corporation shall operate or cause to be operated any ambulance, public or private, or any other vehicle commonly used for the transportation or conveyance of the sick or injured, without having such vehicle equipped with a set of simple first aid and splint appliances approved by the board of health and having in attendance at all times such vehicle is in use a person who has obtained a certificate of fitness as an ambulance attendant from the board of health.

"Any person desiring a certificate as an ambulance attendant shall make application in writing therefor to the board of health. Before the issuance of any such certificate the applicant therefor must present evidence of his qualifications to fill such position and must demonstrate to the satisfaction of the board of health his ability to render emergency first aid and to apply approved splints to arm and leg fractures."

"This regulation, like the Chicago ordinance, does not specify special splints which permit the application of traction during transportation, such as the Thomas-Murray hinged ring splint for the arm, or the Keller-Blake hinged half ring splint for the thigh or leg, but the splints used must be of a type approved by the board of health and the ambulance attendants must understand their use. The board of health will undoubtedly only approve modern methods and splints. This regulation should be a protection to the citizens of Grand Forks and a model for adoption by other cities."

REGIONAL fracture groups can do a great deal for public education in their communities, and each of you should think in terms of your own community. I would like to mention what a couple of regional groups have done.

The Connecticut State Regional Fracture Committee was formed about three years ago. Since that time it has persuaded the Aetna Casualty Insurance Company to make a movie film showing the application of fixed traction. This is one of the very best films on this particular subject. Copies can be borrowed from the Aetna Company without charge. The Connecticut Committee has taken up the problem of making splints at a cheap rate and, by interesting two or three individuals, is now making and shipping a half-ring Thomas for the leg and a Murray-Jones for the arm, in a bag, for the total price of $10. They have interested the

* *Journal-Lancet*, Minneapolis, February, 1937.

Commissioner of Motor Vehicles so that he has published a reprint from *Time* on the subject of spine injury transportation. and has also published a hand-book on first aid, which is widely distributed, entitled "Call the Ambulance."

In Indiana remarkable progress has been made by Dr. Ulmer. The Committee has trained 133 Red Cross teachers. I quote from Dr. Ulmer's report:

"As a secondary result of the teaching these teachers have, in turn, taught more than 5000 first aiders in this field who now hold their first aid cards. When I say 'trained' I mean that they are very efficient in handling first aid injuries, shock. hemorrhage, with the six-point method for controlling hemorrhage, artificial respiration, and traction and fixation for long bones.

"We have first aid committees in the police department, and in the public service (electric and street railway companies, including interurbans), also among ambulance operators, taxi operators, student nurses, schools, colleges, and in about 20 large factories. We have also formed emergency committees for holiday accidents, winter ice accidents, spring aquatic activities, sun strokes, and over-heated cases."

The New York and Brooklyn Regional Committee, under the guidance of Dr. Byron Stookey, has spent the last year in studying means for transportation of neck and back injuries. In its report:

1. The Committee recognizes that the injured spine is first seen and first moved by the lay public and only rarely by the physician.

2. The Committee further recognizes that the first movements of the injured person may further damage the spinal cord, causing additional irreparable paralysis and destroy any remaining function which may have escaped. Recovery is then impossible.

That is what a few of the Fracture Committees have done. That is just a brief resume of their accomplishments. We have yet to take care of athletic contests, football, ball games, and the like. You see some of the most beautiful examples of what not to do on an athletic field—they are carried from a field in a manner you wouldn't want one of your boys carried, and we must tackle them, we must go to them. Dr. Kennedy will remember a year and a half ago when he was present at Madison Square Garden where a track man was injured and was dumped in a stretcher without any fixation. We have taken that up, without much progress to date. We hope, however, to continue.

Now what is one to do if one is trying to educate not only the doctor, but also the public?

THE care of a fracture patient begins when he is injured, and may continue through many trying weeks or months until the anatomical and physiological restoration of function is accomplished and he is returned to his normal economic status.

WHAT DOES THIS CARE DEMAND?

(a) *Mental and Moral Care.* There is only one person whom the patient trusts, and that is the surgeon whom he originally employed. Therefore this surgeon must give encouraging mental stimulus in the early period of pain and, later, he must have sufficient moral force to drive the patient to exercise the injured structures in order to gain restoration of function. The association between doctor and patient is most important in the treatment of fractures. There is usually a fairly prolonged period of disability, where the patient's discouragement may interfere with the eventual result, and much depends upon the moral support of the doctor in charge.

(b) *Physical Care.* The fracture surgeon must have knowledge of the various methods of treating fractures, and must realize that there is no standardization. Each fracture is an individual problem. The location of the fracture, the age of the patient, and his general condition may indicate the line of treatment. In addition to this, the equipment of the surgeon and the physical properties of the hospital influence the type of treatment to be utilized. Speed has very aptly said: "At the risk of triteness, may I quote the slogan: 'It is not the splint but the doctor behind the splint that counts in the treatment of fractures'." Whether the surgeon treats a given fracture by traction, which needs infinite attention to detail in its application and constant observation throughout every 24 hours, observing the various weights and pulleys. or by plaster of Paris, which necessitates a knowledge of the application of a cast so that it will not restrict the blood supply of the limb and yet will give sufficient immobilization to allow healing of the fracture, or by open reduction which demands an operating room well equipped and a surgical team trained for fracture handling, depends upon all of the factors mentioned above. Each method has shown good results in the hands of the master.

(c) *Organization Ability.* If the surgeon is head of a service he must provide for the following setup:

1. Ambulances must be equipped with traction splints and interns or personnel trained in their application. It was conclusively proved during the World War that after the application of fixed traction on the battlefield the injured doughboy was transported to the hospital with much less shock than was noted previously when the lateral splint was applied. His convalescence was shorter, and his disability diminished. For a long period after the War no efforts were made in municipalities to have their ambulances equipped with traction splints. The various regional fracture groups of the American College of Surgeons stimulated various municipalities to equip their ambulances with these splints. Since that time a marked improvement has been noted in the patients who are transported in this manner. In studying the ambulance problem in the United States one finds that about 75% of the ambulances are run by morticians. Public education must be stressed by the medical fraternity in order to see that these ambulances are equipped with traction splints and

that their personnel is trained. The Red Cross, through the initiative of the Committee on Fractures of the College, has already established 2200 first aid stations, and their members are being trained in the application of fixed traction in large part by Fellows of the Regional Fracture Committees.

2. The surgeon must stimulate the hospital staff to treat a fracture as one would an abdominal emergency. This means that the surgical group must be on call to reduce a fracture immediately on its arrival at the hospital, and there must be x-ray facilities for pre- and post-reduction studies during all hours of the day and night and on holidays.

3. Modern medical schools in the United States give too short time to instruction in fractures. Many students do not see any fractures reduced, and those who do see them have little opportunity themselves to handle the patient. This necessitates the surgeon instructing the interns not only in the application of fixed traction but also in the methods of diagnosis, reduction, and after-care of fracture patients.

4. In hospitals where there is not a regular traumatic service and where fractures are of rare occurrence it is necessary to teach the nursing staff the requisites of fracture treatment, particularly in so far as it is associated with either the application of skeletal traction or the mobilization of patients with plaster spicas. The importance of the observation and handling of these cases must be stressed.

5. If the surgeon expects to perform open reductions on fractures he must persuade the Board of Trustees of the necessity of acquiring suitable apparatus for their treatment. He must have discernment enough so that he will not saddle his hospital unnecessarily with gadgets and instruments of torture which high-powered salesmen will attempt to force upon him. Magnuson has said:

"In these days of mechanical advancement we see many devices of strange and wonderful design advocated for the reduction and retention of fractures. Some are very ingenious appliances and to meet a condition which has arisen in a given case, some are strange and mechanical contrivances which it would take a Philadelphia lawyer and a mechanical engineer to apply. They might work if one could apply them, with nothing to bother about but mechanics, but many devices do not take into account the anatomy and physiology of the parts to be treated, and consequently cannot be used successfully in any but the unusual case. Such apparatus confuses, and in the maze of mechanical gadgets the *principles* of treatment of the individual fracture in hand are overlooked and forgotten. There can be no objection to devising an apparatus which serves to answer a need in any case, but to the average surgeon it would be more useful if it were presented as the application of a principle."

The surgeon must develop a technique that must be more meticulous than in almost any other branch of surgery. A good carpenter might make a dowel between fractured ends of bone, but his technique might be so careless that he infect the traumatized bone or be so rough that he damage the surrounding periosteum, muscles and nerves so that fibrosis occurs and muscle elasticity necessary for proper function is lost.

PHYSICAL THERAPY. Allow me to quote from a recent article by Dr. Eliason, on Fractures of the Forearm: "Physical Therapy: A fracture recovers best when the nutrition of the bone and those structures associated with it most nearly approach normal. It has been our experience that the patient himself is his best physical therapist. It should be explained to him that return to function is his job, that only by exercise, supplemented by massage and heat, can he get well. He should be carefully instructed in how to use all of these measures. Aided active motion should be explained to him. Pain is nature's warning of trouble. He will not injure himself—a physical therapist might. If a therapist is on the case, at once the patient transfers all responsibility to his shoulders, feeling that he, only a patient, does not know enough to conduct his own treatment. The individual is his best physical therapist even without the various baths, rays, lights, currents, etc.... Whenever possible, active use should be started immediately after applying a cast."

I agree in general with Dr. Eliason's statement. I believe that there is great value in some of the modalities of physical therapeutics. There is no question that the Smart machine for muscle stimulus, the whirlpool baths and various types of electricity are of great aid in removing fibrosis and helping muscles back to normal tone. Unless the original trauma is tremendous the immediate after care given by the surgeon should avoid the damage to muscles which necessitates physical therapeutic measures. The patient is apt to feel that the responsibility is being shifted when the surgeon transfers him to the physical therapist. If physical therapy is necessary there should be a very close relationship with the surgeon. He must continue to oversee the patient's convalescence, as his moral support is as important as his observation of therapy.

Discussion:

DR. BRADLEY L. COLEY, (New York City): I think you will all agree we have had the privilege of listening to four excellent presentations on the general subject of fractures. I wish it were possible that every word spoken by the four men who presented the four subjects could be compiled into a volume and a copy placed in the hand of every one of us, because, while we have heard what they had to say, it is hard to digest it all and not forget parts of it, and I don't think anything that has been said can well be forgotten.

I am going to try briefly to emphasize one or two points especially worthy of consideration.

In Dr. Wilson's talk on "Fractures of the Elbow," although he practically only covered supracondyle fractures, I think the most important thing he brought out is that the examination is not complete unless the surgeon has carefully recorded on the chart the results of his examination for nerve and circulatory damage. It will save a great deal of embarrassment for him, and to the

claim department, if damage found at a later date was noted as being present at the time the patient sustained the accident.

Dr. Kennedy brought out a number of points of interest, but I was most interested in the question of the transportation of these patients from the site of the accident to the point where they are going to receive their treatment in traction and immobilization by means of the splints which he has done so much to popularize.

I am glad to say that the New York Central System has been made aware of the importance of this method of transporting people with this type of fracture, and, in a number of shops and terminals, we have such splints, together with a box containing the necessary paraphernalia involved, designed after the box which Dr. Kennedy brought out.

I am amazed at the degree of interest which the Chief Surgeons of other systems show toward the fracture problem. Dr. Webb, of the Great Northern, has done some remarkable pioneer work in trying to improve the fracture situation among the roads. He has handled this along three lines: First, the traction-suspension method of transporting the fractures; second, the use by all the company surgeons, all over the line, of the fracture blank which he devised—to make them conscious of the different points they should think of, and thus forcing them to think of those points; and, third, the importance of taking x-rays—making x-ray examinations that are adequate, devising a set of instructions for the radiologists who take the pictures, so as to insure that the x-ray examinations are adequate. In fact, Dr. Webb has a rule on the Great Northern that every fracture case must have the x-rays submitted to him for his examination and his decision as to whether or not that case may safely be left in the locality where it occurred.

Dr. Bancroft spoke about a number of things, and I think the highlight in his talk, striking me as particularly worth stressing, is the fact that each fracture is an individual problem and must be treated as such—wherefore we cannot generalize, or adhere too rigidly to standard methods of treatment, but instead must be familiar with all the various methods that might come up for decision, so that we may pick the one best adapted to any particular case.

It is difficult to say much about the fractures of the ankle, after the way Dr. Murray covered the subject. While listening to him, I thought what a marvelous preacher he would have made, what an able political opponent he would be. I would hate to take the stump against him! He speaks with the conviction that comes from having worked long in his field and having devoted to his subject so much of his time, that he hammers his points home in a way that is refreshing as well as convincing. I hope you all enjoyed his talk as much as I did.

The way he explained the rationale of the short period of immobilization in the unilateral type of fracture is something that will appeal to all of us as reasonable. We will remember it. Then, on the other hand, he spoke of the method of much longer immobilization, and particularly of the longer period before being allowed to bear weight, in the Pott's fracture and fracture of the posterior and anterior lip of the tibia. That, too, will be remembered.

DR. HAROLD H. BAKER (Rochester): I doubt if it is possible for anyone from the West to add to the words of the Wise Men of the East, and I appreciate the opportunity to hear them. But the one thing that impressed me in the papers this morning as most pertinent is the early recognition and individualization of the fracture. To me, this means infinitely more in the treatment of these fractures. It is to be regretted that Dr. Wilson could not finish his remarks on fractures of the elbow, because, in my opinion, they present the most difficult situation that is confronting the average surgeon.

Dr. Murray, of course, is pastmaster in the art of treating this lower leg fracture, and, aside from the fact of his very able exposition, he is always extremely capable in every line of his work. It is very nice to have heard from him again.

In the consideration of the fracture of the shaft of the femur, particularly the oblique fracture, I would like to ask about the desirability, instead of an open reduction or plating, of putting a long Steinman pin through at right angles to the line of fracture, sufficiently long so that after the radiograph shows union or beginning union, that pin may be removed. It has worked for me in many cases, and satisfactorily.

QUESTION: May I ask Dr. Baker whether he includes the pin in the cast or whatever dressing he puts on?

DR. BAKER: We use it either with the cast or in the regular Thomas splint. It is a simple thing to incorporate. You can incorporate the cast right around the pin; and it is easy to remove it afterwards. Unfortunately, you will occasionally get a staphylococcic infection, superficially, but you don't ordinarily get an infection in the deeper tissues.

QUESTION: Dr. Murray did not mention the walking calipers. They are an economy at times, and for malignant fractures have seemed to be efficient. He did not mention them or whether there was any objection to them.

DR. MURRAY: I think they can be applied inside of 48 hours—as soon as the soft-part swelling has gone down. I think it is an excellent thing to apply the walking caliper as soon as the soft-part swelling has gone down. I assume you mean a plaster.

QUESTIONER: I mean the caliper from the knee.

DR. MURRAY: That, I think, can be used on the single malleolar fractures—from 24 hours on. Instead of getting a patient directly out of bed, though, I would recommend that he be allowed to sit up five minutes of each hour the first day, hanging his leg down; and 10 minutes of each hour the second day, and so on. I think, following acute fracture, though, there is frequently a circulatory disturbance. But in the bi-malleolar cases the walking plaster can be used after the period of the knee immobilization has ceased. The patient can then be gotten on a walking leg-iron. That is, except in fractures where there is a fracture of the lower tibia, which is oblique. Those I do not believe are adapted for the use of such calipers.

In the so-called Pott's fracture we do not use the walking caliper, or let me say, have not used it in the past, because of the necessity of keeping a close grip on the tibia and fibula and keeping them pressed together.

If you use the walking caliper, I think it is wise to put between the bottom of the plaster and the bottom of the heel an inch and a half to two inches of sponge rubber so that when the patient walks on it and the plaster slides up a small amount, as it must do, it can't get away because the skin is mobile on the bone underneath the plaster. Many times that is omitted, and the patient is supposed to be walking on the tibia condyles, whereas, as a matter of fact, he is walking on the plaster because it comes directly up against the heel. If the case is operated on and fixed by rigid fixation at the time of fixation we allow the patient to walk without any leg plaster, because we feel that the rigid fixation, assuming it is made rigid, is capable of bearing weight with crutches and after four weeks without crutches.

QUESTION: Where there is a great deal of swelling and you make a good deal of pressure at either side and the swelling goes down, what causes the shrinkage?

DR. MURRAY: I left that point out, in my talk. There is an old saying in fractures, long before modern treatment came into effect, that you ought to wait until the swelling goes down. I don't think there was ever more vicious teaching. But I do believe if you do the reduction after the swelling is down, and it is splinted after the swelling is down, you are in a much better position. And you can do that. But you don't wait for it to go down. What we do is immobilize the part in the posterior splint, elevate it, give it massage, and use the boot which is used for vascular disease, twice a day over a period of 48 hours, and in most cases all the induration can be gotten rid of, and then the plaster can be applied. In fact, it frequently takes only 24 hours; and if you do not see a case until

after all the swelling, etc., has occurred, it is a part of wisdom not to wait for the swelling to go down, but to go after the swelling and then, in 24 to 36 hours, do the reduction, and then you can get the close application of the plaster without risk.

QUESTION: Is there any objection to removing the case and putting on a tighter one?

DR. MURRAY: It should be done if it loosens, but with anesthetic so that you can recompress the parts without hurting the patient. We tried to get around that. One reason we used molded plaster splints on these cases is that if you use elastic bandage instead of the ordinary bandage the elasticity of the bandage will keep the snug fit up against the patient.

On our service we give our nurses a clinic of one hour twice a week on how these patients should be handled after the reduction is done. Unless that is done I don't believe any traction-suspension method can be carried out with the apparatus in any adequate way, nor without adequate working conditions, nor can it be done in so short a time. Secondly, I do not believe splints can be kept adjusted in the presence of swelling. It takes two hours a week to train these nurses what to look for—every time they feed him, change his bed, bring him a glass of water, 20 times a day, they check the apparatus and if there is something wrong they adjust it or report it to the head nurse. That doesn't require extra nurses, equipment or expense. It simply requires two hours of somebody's time twice a week, and it is time damn well spent. But the hardest part of the story is to get the person to give an hour a week to teaching the nurses. I can't blame that on the hospital. If we haven't that time it is our fault.

QUESTION: In practically all of these complicated cases you have swelling. Can you use the boot treatment, and if so, how long can you use it? You say until the swelling is gone; but how long?

DR. MURRAY: Thirty or 40 minutes a day. Of course, though, in using that we ourselves do not feel qualified to give the treatment. Somebody who is trained and capable of judging by the color and rapidity of color changes, and one who knows what pressures to use—not the standard pressures—should be entrusted with this treatment. In other words, it is a matter of using the boot properly, and that will do a great deal. On the other hand, using the boot improperly can do a great deal of harm. It needs somebody trained to the use of the boot, and it is then very effective.

QUESTION: To follow up the treatment of those cases: I think the hospitals should make a point of the nurses being instructed by our orthopedic men—that is a thing that will do a great deal of good towards results.

I appreciate Dr. Murray's remarks about the elastic stocking or bandage. I want to ask, in swelling cases, do you find it is necessary to have the patients carry on the use of this type for any length of time?

DR. MURRAY: If a patient is allowed to get up this is what happens: He will have his leg swell and you give massage, and he gets rid of parts of the swelling, and then it swells again, and what he has is a chronic lymphatic edema. For some strange reason a man can go on for a year and nobody thinks it is anything but water in the leg. Chronic edema induces fibrosis, and if you let it go on he has a chronic edema of the leg. If you prevent the edema, and give the circulation time to remove these excess tissues, he will not have a chronic edema, depending on the amount of the original circulatory disturbance—and I am speaking particularly of lymphatic disturbance. If you put on the stocking before the dependent edema can occur the stocking has to be worn from three months to a year. And the wearing of the stocking in no wise interferes with the man's activity; in fact it allows him to get back earlier. But if you have used it from the beginning the longest period of time that I have ever seen is a year for an ankle fracture. If it is put on later, for persistent edema, he may have to use it for the rest of his life.

Congress on Industrial Health

THE first Annual Congress on Industrial Health, sponsored by the American Medical Association, will be held Monday and Tuesday, January 9 and 10, 1939, at the Palmer House in Chicago. The program follows:

OPENING SESSION, MONDAY MORNING, 9:45

Report of the Council on Industrial Health
STANLEY J. SEEGER, M.D., Chairman, Milwaukee.

SYMPOSIUM ON INDUSTRIAL RELATIONSHIPS

The Physician in Industry and Organized Medicine
IRVIN ABELL, M.D., President, American Medical Association, Louisville, Ky.

The Physician in Industry and the Employer
C. D. SELBY, M.D., President, American Association of Industrial Physicians and Surgeons, Detroit.

The Physician in Industry and the Employee
LOYAL A. SHOUDY, M.D., Chief of Medical Service, Bethlehem Steel Company, Bethlehem, Pa.

Industrial Health and the Private Practitioner
R. L. SENSENICH, M.D., Trustee, American Medical Association, South Bend, Ind.

MONDAY AFTERNOON, 2:15

The Program of the American College of Surgeons in Industry
FREDERIC A. BESLEY, M.D., Chairman, Committee on Industrial Medicine and Traumatic Surgery, American College of Surgeons, Waukegan, Ill.

Uniformity in Workmen's Compensation Procedure
VOYTA WRABETZ, Chairman, Industrial Commission, State of Wisconsin, Madison.

Bases for Cooperation Between Insurance and the Medical Profession
AMBROSE KELLY, American Alliance, Chicago.

A Program for Committees on Industrial Health in the State Medical Societies
A. D. LAZENBY, M.D., Chairman, Committee on Industrial Health, Medical and Chirurgical Faculty of Maryland, Baltimore.

TUESDAY MORNING, 9:30

The Health and Safety Program of the U. S. Bureau of Mines
DANIEL HARRINGTON, Chief, Health and Safety Branch, U. S. Bureau of Mines, Washington, D. C.

The Public Health Interest in Industry—Federal, State and Local
WARREN F. DRAPER, M.D., Executive Officer, U. S. Public Health Service, Washington, D. C.

Industrial Health Activities by Labor Departments in the Government
ALICE HAMILTON, M.D., Consultant on Industrial Hygiene, Division of Labor Standards, U. S. Department of Labor, Washington, D. C.

Independent Programs of Investigation and Prevention
W. J. MCCONNELL, M.D., Secretary Industrial Hygiene Section, American Public Health Association.

TUESDAY AFTERNOON, 2:00

Industrial Surgery from the General Surgeon's Point of View
HARRY MOCK, M.D., Chicago.

SYMPOSIUM ON MEDICAL SERVICE TO SMALL PLANTS

Statement of the Problem
VICTOR HEISER, M.D., and DONALD SHAFER, M.D., Consultants, Committee on Healthful Working Conditions, National Association of Manufacturers, New York.

The Responsibility of the Private Practitioner
CAREY P. MCCORD, M.D., Director, Bureau of Industrial Hygiene, City of Detroit Department of Health.

Means for Accomplishment
GLENN S. EVERTS, M.D., Melrose Park, Pa.

Methods of Appraisal
L. D. BRISTOL, M.D., Health Director, American Telephone and Telegraph Company, New York.

Industrial Hygiene Meetings

—Abstracts of Papers presented in the Industrial Hygiene Section, Sixty-Seventh Annual Meeting, American Public Health Association, Kansas City, Mo., October 25-28,1938—

C. O. SAPPINGTON, M.D., DR. P.H.,
Consulting Industrial Hygienist
Chicago

FIVE sessions of the Industrial Hygiene Section of the A. P. H. A. were held at the Sixty-Seventh Annual Meeting, at Kansas City, October 25-29, 1938. The speakers and subjects follow:

1. LUNCHEON SESSION, October 25. Reports of various committees and brief talks by DR. R. R. SAYERS and DR. LEONARD GREENBURG with reference to the International Silicosis Conference held recently in Geneva and also the VIIIth International Conference on Industrial Accidents and Diseases, at Frankfort am Main.

2. FIRST SESSION—Symposium on Industrial Hygiene Administration:

(a) Address of the Chairman of the Section: "Development of Industrial Hygiene in the United States"—J. J. BLOOMFIELD.

(b) "Health Maintenance in Industry" — CLARENCE D. SELBY, M.D.; discussion, WILLIAM A. SAWYER, M.D.

(c) "Industrial Hygiene Program in a State Health Department"—CARL A. NAU, M.D.; discussion, MANFRED BOWDITCH.

3. SECOND SESSION—Symposium on the Control of Industrial Hazards:

(a) "The Safe Operation of Degreasing Tanks Employing Trichlorethylene"—W. B. HARRIS, C. B. FORD, and F. A. PATTY. (Presented by DR. LEONARD GREENBURG); discussion, HENRY FIELD SMYTH, M.D., DR.P.H.

(b) "Industrial Hygiene Codes" — JAMES R. ALLAN; discussion, O. T. NELSON.

(c) "The Effect on Health of Gases Produced by the Electric Arc"—LEROY W. LATOWSKY.

4. THIRD SESSION:

(a) "Time Lost by Industrial Workers from Disabling Sickness and Accidents during the Early Days of Disability"—WILLIAM GAFAFER, D.Sc.; discussion, R. D. MUDD, M.D.

(b) "Asbestosis" — R. R. SAYERS, M.D., and WALDEMAR C. DREESSEN, M.D.; discussion, ANTHONY J. LANZA, M.D.

(c) "The Administration of Laws for the Prevention and Control of Occupational Diseases"—THEODORE C. WATERS; discussion, C. O. SAPPINGTON, M.D., DR.P.H.

5. JOINT SESSION—Industrial Hygiene and Public Health Nursing Sections: presiding, J. J. BLOOMFIELD and MARY J. DUNN, R.N.

(a) "Practical Methods for the Control of Hygienic Exposures"—G. A. COBURN; discussion, CHARLES L. POOL.

(b) "Industrial Medical Department Organization"—JOHN J. PRENDERGAST, M.D.; discussion CAREY P. MCCORD, M.D.

(c) "Industry's Challenge to the Nurse" — LAVONA BABB, R.N.; discussion, JOANNA M. JOHNSON, R.N.

CHAIRMAN BLOOMFIELD, in his address, discussed the subject of health as affected by factors outside of industry and stated that we must approach the situation from the public health point of view. The health problem as a whole applies to all those gainfully employed. The death rates have been shown to be higher in certain industrial groups than in the general population. It is difficult to reach workers in the small industrial groups because the cost of health supervision reaches a higher average. Among the problems in this field are: (1) disability due to lost time accidents is still important—we have not yet approached the minimum rate; (2) certain occupations are associated with poisons; (3) the lack of physical capacity in oldsters; and (4) the matter of absenteeism due to other than industrial factors. There has been no significant advance in increasing longevity among those in middle life. The average loss yearly due to sickness is 7.5 days in males and 10.5 days in females, according to certain experiences. Especially important is the problem of chronic disease in younger workers. Workmen's compensation laws have stimulated prevention activities; research in Federal agencies and universities has increased and has met more than the limited previous application prior to 1936; through the social security funds we now have 26 state bureaus of industrial hygiene and three-quarters of a million dollars is being expended on this work. Incidentally the 15 mills expended per worker is a small amount in comparison with the money spent for compensation and other similar purposes. We must not lose sight of the fact that industrial hygiene is really adult hygiene. The amount of time lost from the relatively important occupational diseases is shown by the statistics of Wisconsin for the 16-year period—1920 to 1935 inclusive—in which occupational diseases accounted for 2% of the compensation costs and which rose in 1935 to 2.8%. Illness causes far greater loss of time than injuries and if the general health status in industry is to be improved, we must give consideration to general adult health programs. The essential features are: (1) research; (2) application of research; and (3) educational activities. In the application of the program, the nature and scope of the industrial hygiene problem should of course be determined—a preliminary survey of potential hazards is indicated, as well as a survey of the sickness records—the use of benefit association data, already being collected at the present time; the second item in the program

is the working out of methods of control and their application; and another item is the use of sources of information which are now located in various agencies. We may well compare the approach in school health work to the approach on adult hygiene in industry—we must bring public health to the factory. The integration of this work should be done by persons trained in industrial hygiene. In conclusion, we should supplement the present information with occupational data with reference to general health losses; we should consider the industrial hygiene problem as one of adult health and develop strong units along this line. In this way, the general health status of workers will be improved.

DR. C. D. SELBY, in discussing "Health Maintenance in Industry," stated that the worker is employed in industry about 25% of his time, but that occupation is responsible for only 6% of his annual disablement. The maintenance of health in the community is, therefore, important and the community health program should include non-occupational diseases. The treatment of industrial injuries and disease is an essential in any industrial program and the recognition of the importance of specialized services in this respect is vital. The treatment of occupational injuries and diseases is still a major part of industrial medicine. Plant studies and special examinations are necessary and it is also of great importance to correlate these findings. Industrial hygiene properly belongs in the medical department. Placement is the only object of pre-employment examinations. Building up confidence and goodwill is the bulwark of industrial health. Periodic examinations are essential for the control of occupational diseases. Re-entrance examinations after returning from illness and injury are a part of the program. Industry has found one of its most valuable services in relation to counsel for employees on health matters; treatment should be referred to the private practitioner. Records should be kept in such a way that they will be satisfactory for statistical studies. The case-finding function in industry has far-reaching value in health maintenance; corrections of defects should be referred to private physicians. This work has been of special importance in relation to tuberculosis, syphilis and cardiovascular disease. The opportunity for the accumulation of data in respect to non-occupational diseases is an unusual one in industrial medicine and industry should contribute its share in this problem. Cooperation with the local medical profession taking the form of the plant physician becoming a valuable ally to the local medical profession cannot be overemphasized. Industrial medicine represents the only organized plan for an attack against diseases in the employed group and in this respect there is great opportunity for epidemiological studies. In conclusion, the industrial physician can contribute substantially to the health of the community and can thus raise his own standards. The statistics relating to nonindustrial sicknesses will prove to be of great value.

Dr. Selby's paper was discussed by Drs. Kibbe, Bristol, and Sayers, and by Miss Joanna Johnson, and Dr. Peterson. In this discussion, especial emphasis was placed upon the pre-employment examination being used solely for placement; in the health program in industry the slogan is preventive maintenance and the procedures are somewhat similar to school hygiene and school health services; the keeping of illness records with reference to absenteeism is vital; the nurse can be a very helpful person in the integrating of industrial and community health; the education of the undergraduate and the practicing physician can be an important phase of this problem in the future.

DR. NAU, in presenting the subject of the "Industrial Hygiene Program in a State Health Department," stated that many persons have not considered the place of the private practitioner in the industrial hygiene program. This program depends upon two factors—its definition and its objectives. It requires the close cooperation of many groups, and at this time government should be added to the usual groups named. The viewpoint of this program should involve (1) consideration of the worker himself; (2) consideration of the environmental conditions; and (3) consideration of the study of society in general with the idea of "selling" the program. The division of industrial hygiene should serve as a clearing house for other divisions in state departments, but should not compete with the private practitioner. Records of absenteeism should be complete. In order to justify itself, industrial hygiene must broaden its program. In a survey of the environmental conditions, the division of industrial hygiene should act as a go-between for the other divisions of the health department. Probably over-emphasis has been placed on occupational disease — we need more health engineering in general. The task of bringing all groups interested together and coordinating them is colossal. Experiences should be made available through central agencies. In summary, industrial hygiene programs should be initiated in the state department of health—industrial hygiene should be considered as a public health problem—qualified personnel should be used—the division of industrial hygiene can act as a coordinating agency and as a clearinghouse—and finally, the general health program is of the utmost importance.

Dr. Nau's presentation was discussed by Drs. Gray, Greenburg, Sappington, and Flinn. There was a striking similarity between the papers of this session in that they all emphasized adult health activities as an important part of the industrial hygiene program. It is of course right to emphasize adult health, but there may be certain instances of chronic disease due to occupational exposure. It is a fact, however, that we are still not doing a real job in the prevention of occupational disease and this must be done if we want to prove the case of industrial hygiene. There is a close similarity between the relationship of health supervision in schools and in industry. The edu-

cation of the physician with appropriate internships forms a real background for qualified personnel.

Second Session

DR. LEONARD GREENBURG, in presenting the subject "The Safe Operation of Degreasing Tanks Employing Trichlorethylene," stated that we are confronted by the problem of encountering many degreasing machines with the hazards common to them. Trichlorethylene is stable to about 125° C, and then starts slowly decomposing with the formation of hydrochloric acid. It is nonflammable but may decompose, forming phosgene at high temperatures. There have not been significant amounts of phosgene found in the surveys on which the present report is based. It is well to remember also that trichlorethylene decomposes to form phosgene in the presence of powdered aluminum which acts as a catalytic agent. In reference to the physiological effects, in this survey, the investigators failed to find an agreement as to the toxic limit which is agreed upon by various authorities. It was attempted, therefore, to pick up the worst exposures making selections among 50 plants, in which there was a detailed study of 15 of these plants. Symptoms complained of after appreciable exposures to trichlorethylene are headache, dizziness, nausea and malaise. No chronic effects were observed in these studies. A series of lantern slides showed the structure of the degreasing tank with the attached heating system and the water condenser; a high exposure is encountered very often in the draining and cleaning of the tanks. Loss of trichlorethylene vapor presents both a hygienic and economic problem. Detailed recommendations were given for temperature maintenance in the heating and condensing units. The feeding and removal of contents of the tank by automatic means was considered best. Among factors of protection mentioned were: the use of tanks which are sufficiently large—the following of instructions issued by manufacturers—control of the rapidity of production rates (in one study it was found that there were 500 parts per million as noted by the portable interferometer, this being lowered to 300 parts per million and still remaining in this range although good equipment was used—it was considered that the cause was pushing production),—maintenance of proper temperature of parts and consideration of their shape—keeping the solvent clean by frequent distillation and by the cleaning of the tank. It was discovered that high losses of trichlorethylene vapor are associated with poor tank construction and bad location—it was particularly emphasized that in rooms above 20,000 cubic feet volume, conditions of exposure were probably satisfactory, being in the neighborhood of 150 parts per million in the vicinity of the operation. Pit locations should be avoided and positive ventilation should be used where necessary. Locations should also be avoided near spray booths on account of cross drafts. The necessity for special ventilation in rooms under 20,000 cubic feet capacity was emphasized, and also the use of such ventilation where other ununiform factors are present. Recommendations from these studies were based upon previous findings and include advice for the use of standard manufacturing tanks which would be large enough for complete immersion of the products, equipped with safety thermostats and a flue from the combustion chamber among other things; tanks should be located perferably in rooms of over 20,000 cubic feet capacity, avoiding pits or pockets, locations near spray booths, and drafts—it is important also to prevent negative pressure in the operating room. In all locations which are not in large rooms, local exhausts should be used, making use of lateral movement into slots. A ventilating booth for tables for proper cooling of parts should be provided. Finally, the tanks should be operated according to manufacturer's instructions, should be kept closed when not in use, and the workers should be provided with absorbent respirators. Several lantern slide illustrations showed the use of the tanks in a large room, a graph demonstrating the rate of air changes per hour, a poorly located tank, and also a tank with exhaust ventilation about the perimeter.

Dr. Henry Field Smyth, Sr., in opening the discussion of Dr. Greenburg's paper, thought it necessary to emphasize the problem of toxicity. Although no definite concentrations have been agreed upon as being threshold limits according to the experiences in the literature, we must consider trichlorethylene as potentially hazardous and learn how to use it properly.

MR. JAMES ALLAN spoke on industrial hygiene codes. In comparing safety codes and studying them, it was later realized that codes were necessary in occupational disease work. Investigating the matter of grinding, polishing and buffing operations, it was found that there was no correspondence in protective recommendations as obtained from different sources. The foundry industry realized the necessity for drafting industrial hygiene codes and now this whole industry has been thoroughly covered. It was found necessary first to determine simple methods for the measurement of air flow—second, it was necessary to outline methods for the design and operation of exhaust systems—third, a code for grinding, buffing and polishing was devised, and fourth, an all-inclusive metal cleaning code was set up. It was noted that employers, manufacturers, factory personnel, and official agencies all can make a contribution. It is especially important that technical information be available to small plants. Referring to the use of codes legally, it is a better method to have an enabling act to assist the legislature in reference to general code requirements, than to take the chance that code provisions might become statutory. Finally, every industry should develop a code for the prevention of occupational diseases within its group.

In the absence of Mr. O. T. Nelson to open the discussion, Dr. McConnell read Mr. Nelson's discussion. Codes must be prepared by those who

have technical knowledge and must be general and not specify details because of difficulties which may result from such specifications. Reference was made to the development of Wisconsin's codes. Sufficient flexibility must be provided in these codes, and as an important point in Wisconsin reference was made to the fact that orders could be modified without legislative action. The paper of Mr. Allan was further discussed by Drs. McCord and Greenburg. Dr. McCord gave a resume of his experience with the formulation of codes at the present time in Detroit, based upon the consideration of substances rather than industries; he also emphasized the great need for flexibility. Dr. Greenburg commented on the New York experience, particularly with reference to the flexible arrangements relating to supplemental advice.

DR. LEROY W. LA TOWSKY presented a paper concerning the clinical and experimental phases of the effect on health of gases produced by the electric arc. Attention was first drawn to a recent survey published in the current issue of *Monthly Labor Review*. Another survey in motion picture booths in Omaha brought out the necessity for making a study of exposures in this occupation. The oxides of nitrogen may reach uncomfortable amounts if not toxic ranges, it was assumed. The study showed that such was the case and that furthermore, in experimental work toxic amounts were generated where no ventilation was provided. Fellowships were established at Harvard and Nebraska and some of the resulting research material has already been published in the *Journal of Industrial Hygiene and Toxicology*. A number of lantern slides were shown depicting the apparatus for the measurement of gases and also for gassing animals. In this survey, concentrations of nitric oxides were found to be in the range of 100 to 200 parts per million. Another slide was exhibited, showing the chemical reactions to the various oxides of nitrogen. It was found that carbon dioxide existed in the range of 2000 parts per million. In the filtered arc fumes, the rare earth oxides composed most of this material, especially those of cerium, lanthanium, and neodymium. In the experimental work, exposures to gross arc fumes and filtered arc fumes were done on animals; experiments were also done with reference to exposures of pure nitric oxides in the range of 100 to 200 parts per million and also to arc ash. The acute effects were characterized by methemoglobinemia and edema of the lungs in reference to gas exposures; where there was exposure to unfiltered fumes, there was dust phagocytosis, a pneumonitis, and fatty degeneration. Slides of postmortem changes were shown. Where good exhaust ventilation is provided, no difficulty should be experienced regardless of the kind of arc used. Regardless of the type of general ventilation used in motion picture projection booths, the regulation providing not less than 200 cubic feet per minute per lamp has been found to be effective. Recommendations of Drinker and Snell were cited. In conclusion, it was stated that a toxic range of gases and fumes exist (particularly with reference to the oxides of nitrogen) if the air is undiluted. The acute and chronic exposures in experimental animals were capable of causing death.

Discussion of this presentation was given by Drs. Phillipe, Sayers and Mr. Case. Emphasis was placed on a better delineation of toxic limits of the oxides of nitrogen and more general acceptance of threshold limits. The suggestion was made that the Industrial Hygiene Section draw up standard recommendations for use in the protection of workers in occupations where the electric arc is used.

Third Session

DR. WILLIAM GAFAFER presented statistics particularly with reference to short time disability from sickness and accidents, in industrial workers. Reference was first made to the report on occupational mortality by the British which is now available and which has been reviewed in the *Lancet*. It seemed that there was a remarkable opportunity in getting one-day absences and upward, the work covering the period of 1933 to 1937 inclusive. In the benefit associations with reference to this study, there were 12,969 males and 3,272 females. The causes of disability were grouped under large headings, as respiratory, digestive, non-respiratory, non-digestive, industrial accidents and non-industrial accidents. Lantern slides were used to good advantage, giving tabulations of the data; and the data were presented in different tabulations running up to the 21st day of absence in certain groupings and up to the 372nd day of absence in the whole series. Regarding absences through the 21st day, 60% of the first day absences of males was due to respiratory disability, 16% to digestive troubles and 2% to industrial accidents. As to frequency of absences, there were 900 per thousand on the first day in males and 1800 per thousand for the first day in females; these had receded to 59 and 83 on the 21st day respectively. In regard to the total amount of time lost, this was found to be 97,504 days in males, of which 39% was due to respiratory disabilities—and 35,518 days in females, of which 49% was due to respiratory disabilities. An interesting point was shown in the fact that during the first 21 days of disability due to non-respiratory and non-digestive causes, females showed an incidence of 60% and the males an incidence of 42%.

In summary, in the one or more days' absences studied, the males had 11,602 absences and the females 5,596 absences; males showed 45% absenteeism and the females 52% absenteeism due to all causes; of the disability due to respiratory difficulties, 67% of the absenteeism occurred in males during the first seven days and 62% in females during the same period.

Dr. R. D. Mudd, in opening the discussion of Dr. Gafafer's paper, stated that this study indicated the relationship of disabilities of less than and more than eight days duration and showed particularly that we are missing 44% of the lost time if the first seven days are not included and 67% of the respiratory disabilities if such a period is not included in

any proposed study. There is some difficulty in making studies of this sort in plants which operate four or fewer days per week. Slides of record forms for recording disabilities were exhibited. A foundry experience was also demonstrated, in which the disability was greater after the 14th day than that shown in Dr. Gafafer's figures and also vice versa. The reason here is probably because of not including the one and two day absences. Dr. Mudd concluded that such studies as those made by Dr. Gafafer and the Public Health Service are important in pointing out some of the places for investigation in industrial health surveys.

In further discussion, Dr. Leonard Greenburg pointed out that perhaps the inherent differences in occupations and in types of people in these occupations may account for the differences in the figures between the studies made by Drs. Gafafer and Mudd.

DR. R. R. SAYERS presented a paper on the subject of asbestosis. There was first a review of the history of the literature from 1900. Lantern slides were shown taken from the tables in the Public Health Report of this study having reference particularly to the dust findings; relation of fibers to particles in various processes; particle distribution by operations; tabulation with reference to the size of fibers; and other relationships. A short discussion on the definition of the word "asbestosis" and the symptomatology was given. Slides were also shown with reference to the correlation of occupations and the occurrence of asbestosis bodies; the relationship of exposures in occupations to symptoms; the relationship of occurrence of symptoms and exposures; the incidence of ground glass markings on the x-ray in reference to dust exposure; a comparison of the x-ray findings and the symptoms; and a tabulation relative to the occurrence of asbestosis with reference to dust concentrations and years of employment. In summary, asbestosis was the principal defect found on medical examination of 541 men and women employed (or recently employed) in three asbestos textile factories. Of the 445 employed at the time of the study, 73 were found to have asbestosis. The field work was carried out in North Carolina in cooperation with the State Board of Health and the Industrial Commission of North Carolina. A fine, interstitial, pulmonary fibrosis accompanied by asbestosis bodies is the essential pathology of asbestosis. During life, the chest x-ray film shows rather characteristic markings. The processes that produce dust in the asbestos textile factories were studied and summarized results are incorporated for both controlled and uncontrolled conditions. A concentration of five million particles per cubic foot is considered as a tentative threshold. Study of processes in the three plants, as well as those studied elsewhere by the Public Health Service, suggest that this threshold can be reached.

Dr. W. J. McConnell, in the absence of Dr. A. J. Lanza, opened the discussion on the presentation of Dr. Sayers. It was pointed out that it is not sufficient for a diagnosis to demonstrate asbestosis bodies in the sputum, although this is still being done. The nature of the reaction and the type of injury in asbestosis has not yet been demonstrated, although Gardner found injury more rapid from relatively larger fibers than the smaller ones. Further discussion was also given by Dr. Harry Wilson, Dr. Albert S. Gray, and Dr. H. I. Spector, contributing experiences relative to control measures in plants with excess of exposure, the importance of the fact that we now have a tentative threshold dose established and the need for expertness in chest diagnosis, particularly with reference to differentiating tuberculosis from dust conditions.

MR. THEODORE C. WATERS presented a paper on "The Administration of Laws for the Prevention and Control of Occupational Diseases." Occupational disease compensation laws have been of comparatively recent enactment, the states of California and Wisconsin having passed such laws in 1919—New Jersey in 1924—North Dakota in 1925—Minnesota and Connecticut in 1927—and, what is of great importance, the remaining 15 states have enacted their laws since 1930. There is still a great deal of controversy as to the relative efficiency of the "general coverage" and the "schedule systems. There is the necessity of defining what occupational disease is when the general coverage system is followed. Several instances of this were referred to in the discussion. Of particular interest to the American Public Health Association are provisions for the creation of medical boards or the appointment of medical examiners, and provisions for the establishment of bureaus of industrial hygiene. The functions of medical boards or medical examiners were given as follows: (1) to advise the administrative agency whether or not the claimant is suffering from occupational disease for which compensation is claimed; (2) to determine the degree of disability caused by the occupational disease; and (3) in death cases, to supervise the conduct of autopsies. With reference to provisions for the establishment of bureaus of industrial hygiene, the functions of these bureaus may be mentioned as follows: (1) the maintenance of reporting systems; (2) the establishment of rules and regulations for the control and prevention of occupational diseases; and (3) maintenance of the factory inspection service. The laws of the States of Connecticut, Delaware, Missouri, Nebraska and New Jersey make no provisions for the appointment of medical boards or medical examiners; in the laws of other states, such provisions are made. Massachusetts and Michigan make the diagnosis and the opinion of the board upon medical questions binding upon the agency administering the law. In the States of California, Illinois, Indiana, Kentucky, Minnesota, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, Washington, West Vir-

ginia, and Wisconsin, provision is made for the medical boards and examining physicians to act in an advisory capacity to the agency administering the law. It is believed that the importance of medical boards cannot be over emphasized because the successful administration of occupational disease laws will depend upon the proper determination of medical questions of fact that are involved in the claims; furthermore, there is no agency in the United States whose voice should be more effective for the accomplishment of the desired results in this respect than the American Public Health Association. With reference to functions of bureaus of industrial hygiene, the maintenance of reporting system would be of material value to make known to state officials those industries wherein potential occupational disease hazards exist, so that effective methods for control could be adopted. There would also be a great amount of valuable statistical data accumulated for the purpose of determining the effectiveness of programs for prevention and the cost occasioned by occupational diseases. The establishment of rules and regulations for the control of occupational diseases through surveys and studies of various industries, as well as the maintenance of a factory inspection service, were also emphasized. In conclusion, it was stated that the relatively recent enactment of most of these laws is important to keep in mind —we have not yet had sufficient experience with their administration in order to determine whether or not that administration has been or will be successful. The laws however, represent a step forward in our industrial relationships. Moreover, it is good business to prevent disease and injuries rather than to compensate for them and it is hoped that in the future primary emphasis will be placed upon prevention so that compensation will not be necessary.

Dr. C. O. Sappington, in opening the discussion of Mr. Waters' paper, emphasized the point that the successful administration of these laws involves an intimate knowledge of the intricate associations of employment, disease and disability and also the establishment of cause-and-effect relationships; that many of the difficulties arising thus far have been occasioned by the belief in the fallacy that the methods used in reference to industrial accidental injuries were also of use here; that the use of vague and indefinite wording in our terminology and definitions and in the laws, breeds controversy; that there are and will continue to be (to borrow a phrase from Dr. Nau) "chiselers on both sides." It is necessary also to remember that whatever definition of the term "occupational disease" may be satisfactory medically, such definition must eventually, however, be construed by the courts. In this respect, the language of the court in *Goldberg* v. *Marcy* hardly leaves room for doubt as to what is legally meant by the term "occupational disease." It is pointed out, however, that there would be no necessity for such construction where the so-called schedule system of naming the diseases is in effect. It is agreed that the medical board is an important group, especially with reference to the competency, impartiality and nonpolitical affiliations of the personnel composing it; we should not, however, overlook the fact that such men are unusual, and furthermore, it should be arranged so that the tenure of office can be secure and the financial consideration commensurate. The industrial hygiene bureaus have done very effective work and in this respect a reporting system would be of tremendous importance to the industrial epidemiologist—we must first convince the employer, however, that he will not be penalized if he reports his cases regularly, if we expect the system to be successful. It was finally pointed out that the Industrial Hygiene Section of the American Public Health Association has been very close to various developments in this field and that the section has a definite responsibility to the public to make knowledge and experience readily available for the help of legislators, administrators and other workers of this type. It was suggested, therefore, for the consideration of the officers and the section council that it might be well to consider the creation of a medical board committee for the purpose of studying the functions of medical boards and supplying a list of qualified physicians to act on such boards in the various states, and further the possibility also of the creation of a legislative committee for the purpose of advisory work in reference to the formation and administration of laws and codes.

In the further discussion of Mr. Waters' paper, Drs. Winslow, Greenburg and Huntington Williams participated. It was believed that it was not necessary to resort to the services of supermen in order to obtain good medical boards—that impartial medical men had a different mental attitude when put on medical boards than they do when giving professional testimony in courts or before commissions. In the New York experience, as cited by Dr. Greenburg, medical examiners have been appointed in the five state compensation areas and further, a special medical board of three men has been appointed to take care of dust problems. This experience has been very successful. Dr. Williams suggested that the health officers should be more interested in industrial hygiene and occupational diseases and should do more along these lines; perhaps a joint session of the two sections would be of value in bringing out more clearly the necessity for interrelationships.

Joint Session

THE Friday afternoon session was a joint session between the Industrial Hygiene and Public Health Nursing Sections.

MR. G. A. COBURN discussed "Practical Methods for the Control of Hygienic Exposures," and supplemented his discussion by a great many interesting lantern slides, showing the detail of foundry

installations with reference to various types of exhaust ventilation apparatus and particularly applied to different industrial operations. The kinds of exposures, the nature and extent and control of them, were specifically considered and also the details of industrial hygiene surveys outlined. Emphasis was particularly placed on delegating responsibility to one person or some group of persons for these procedures. Detailed recommendations were made for the control of exposures and the protection and selection of workers. Dusts were divided generally into two groups, those injurious to the lungs and those causing systemic poisoning. In the experience of the speaker, 4000 feet per minute is routinely used for the exhausting of dusts and 5000 feet per minute for exhausting of lead dusts or fumes. It has been found to be the simplest way to establish a maximum of five million particles per cubic foot for the solution of practical problems in dust control.

Mr. Charles L. Pool, in discussing Mr. Coburn's paper, presented a discussion in the nature of a mimeographed symposium, gathered from various persons as follows: Dr. Albert S. Gray, Mr. Benjamin F. Postman, Mr. J. B. Lamenzo, Mr. S. W. Gurney, Dr. Wilmer H. Schulze, Mr. Manfred Bowditch, Mr. W. C. L. Hemeon, Mr. S. C. Rothmann, Mr. Ernest Boyce, Mr. Arthur L. Nichols, Dr. Carey P. McCord, Mr. Theodore Hatch, Mr. R. C. Stratton, Maj. Joel I. Connolly, Mr. Sol Pincus, and Dr. Leo Tobias. Extracts from the experiences of these men together with drawings of installations made up the symposium-discussion and presents an unusual opportunity for the preservation of the information gathered over a wide experience.

DR. JOHN J. PRENDERGAST presented the subject "Industrial Medical Department Organization." It was pointed out particularly that 98.6% of employees work in groups containing less than 500 workers. This does not mean that industrial hygiene laboratories and personnel to carry out proper procedures are not important in large groups; however, the large group usually has made provisions for this type of program. The nurse becomes a very important figure, therefore, in the smaller industrial groups and the qualifications of the industrial nurse were specifically considered. The place of the nurse in smaller industries was discussed especially with relationship to the accessory functions of the nurse which are not strictly medical; it is realized, however, that the nurse can make herself of greater value if these accessory functions are developed to the greatest degree and can, therefore, establish herself on a firm footing, especially in the smaller industries, if this principle is followed.

Dr. Carey P. McCord, in discussing Dr. Prendergast's presentation, spoke of four different zones based on the number of employees in different industrial groups and their relationships to industrial hygiene activities: Zone 1 includes those groups having above 1000 employees—there is no worry here as to the type of work being done; Zone 2 includes groups having 400 to 999 employees—in this group one finds a few full-time doctors and nurses and usually general welfare and personnel work is done through the medical and nursing departments; Zone 3 includes groups of 50 to 399 employees and for the most part there is here a great opportunity for the industrial nurse, although there is no real specified training for this type of so-called "all-around" nurse; Zone 4 embraces those organizations which have less than 50 employees and which rely on various agencies for medical, nursing and hygienic services. It was, therefore, pointed out and emphasized that the well-trained industrial health nurse is the real key person for various types of activities in the smaller plants.

LAVONA BABB, R.N., presented the last paper in the Industrial Hygiene Section meetings on the subject "Industry's Challenge to the Nurse." The nurse is in a strategic position in industrial plants and may partake among others in various activities as follows: health and safety education; cooperation of city and state health programs with industrial programs; making of the plant a more healthful place to work; recreational programs; physical examination programs, particularly with respect to follow-up work and records. There are also other activities in which the nurse may engage and these were discussed. The question which naturally arises and which the nurses themselves must answer is, whether the nurse is prepared to accept this challenge.

In opening the discussion of Miss Babb's paper, Joanna M. Johnson, R.N., stated that there was a great opportunity to coordinate social and health agencies in community health procedures. The nurse likewise has a great opportunity to do follow-up work in the correction of physical defects and help the medical department as well as management in this important procedure. A great deal has been said about the use of "Standing Orders" which have now been superseded by what are known as "Suggestions" for nurses. It apparently was found that there was some misunderstanding arising because of the use of standing orders and it was better not to have them issued as orders. The importance of "refresher courses" for nurses in industry was brought out and suggestions made regarding this important kind of "keeping up" for the industrial nurse. Experience recently in Milwaukee was cited referring to the fact that Milwaukee has four joint section meetings a year in which the nurses and physicians and others interested discuss their common problems.

[NOTE: DR. JAMES E. M. THOMSON desires us to publish the following: "In a recent article entitled "Pectin in the Treatment of Infected Wounds" (INDUSTRIAL MEDICINE, July, 1938, p. 441) the author wishes to acknowledge the work of MATTHEW WINTERS, EDITH HAYNES and GRACE WASHBURN, who were associated with DR. CHARLES TOMPKINS in his work at the University of Indiana at Indianapolis, with respect to the clinical and laboratory deductions in regard to the use of pectin in infantile diarrhea and in the treatment of wounds."]

Safety Congress Meetings

—Abstracts of Papers on Occupational Diseases, Industrial Hygiene, and Medical Service, presented before the Twenty-Fifth National Safety Congress and Exposition, Chicago, October 10-14, 1938—

THE Session on Dust, Fumes, Gases and Vapors was held on October 12, under the Chairmanship of WALTER S. PAINE, Mgr., Engineering & Inspection Dept., Aetna Casualty & Surety Co., Hartford, Connecticut, and Vice-President for Engineering, N.S.C. There were two papers:

"Recent Developments in Detecting Hazardous Dusts, Fumes, Gases and Vapors," by WARREN A. COOK, Supt., Engineering Dept., Zurich General Accident & Liability Insurance Co., Chicago; and

"Men Who Go Down to Their Death in Tanks," (Demonstrated), by S. E. WHITING, Chief Engineer, Liberty Mutual Insurance Co., Boston, assisted by volunteer "victims" and emergency equipment loaned by the manufacturers.

MR. WARREN COOK presented material which included a brief discussion of methods commonly used and the interpretation of results of such methods. Gases and vapors are, for the most part, invisible and many are undetectable by odor.

There is considerable difference between the number of persons exposed to various substances and the actually existing hazard. For example, the U. S. Public Health Service found in its industrial survey several years ago that approximately 20% of persons were exposed to carbon monoxide—this, however, does not represent the actual hazard present in these industries. It is suggested than in each plant responsible persons look over the operations where such exposure may exist; this should also be done in reference to other vapors and dusts and fumes.

An important consideration is the intelligent use of existing methods so applied as to get the worst exposure conditions. Various methods were referred to, particularly those from the American Public Health Association committee on chemical methods of investigating atmospheric pollution and also the Air Hygiene Foundation methods as recently published.

In regard to dust methods, the impinger is recommended, supplemented by the konimeter and similar apparatus. For lead dust, the impinger is recommended, and for fumes both the impinger and electric precipitator have been used. For carbon monoxide, the detector and indicator is used.

In regard to the chlorinated hydrocarbons and the hydrocarbons in general, mention was made of various specific tests, including the interferometer which is classified as non-specific and high-priced.

In a survey of the various laboratories which are doing chemical analyses and industrial hygiene work, it was discovered that lead, hydrogen sulphide, carbon monoxide, mercury, sulphur dioxide, ammonia, and chlorine were the analyses which were done most frequently in order as named.

In conclusion, it was stated that chemical determinations of dusts, fumes, gases and vapors are of real value, if intelligently used; representative samples should be collected for analysis, which should include variable conditions of operations, under which such samples should be collected. The interpretation of the results is of greatest importance, and one should not read more into the results than there is present.

Discussion included the subject of arc welding and reference was made to Drinker's work on this subject. The possibility of arsine exposure in pickling processes brought forth the statement that there had been no investigation of this problem in America, and that there had been no American cases reported, although several had been written up in Canada. As to the question of the impinger versus the electric precipitator in collecting lead fumes, investigations have shown that we are not going wrong on using the precipitator for the determination of lead fumes. Where comparisons have been made, it has been found that the electric precipitator should not confuse the issue, but should clarify the results.

MR. S. E. WHITING stated that there are many tanks used in industry everywhere and also that there are other enclosures, such as pits, basement rooms, vaults, compartments in ships, wells, silos, grain bins, and sewers, which offer problems of similar capacity.

The absence of free circulation of air in such enclosures changes conditions unexpectedly, producing at times a severe hazard.

Remembering that the normal atmosphere contains 20% oxygen, it should be also emphasized that difficulty is experienced when the oxygen gets as low as 15%, and that below 10% oxygen content of the air human beings exposed collapse.

There are also other troubles encountered, namely carbon monoxide, hydrogen sulphide, and various gases. Carbon dioxide may also give trouble in sufficient amounts, although it is useful in resuscitation measures in 7% mixture with 93% oxygen. Carbon dioxide has a tendency to "pocket" because it is heavier than air and is usually cool.

In demonstration No. 1—inside a tank which was transparent so that the audience could see what was going on—three men entered without appropriately testing the atmosphere; the first man was overcome; the next man appearing saw this man and went in, also without any method of protection; the third took a canister mask which was not a protective mechanism in this instance and, therefore, all three collapsed and were incapable of self-rescue.

In demonstration No. 2, various tests of the atmosphere were made and safety lamps were lowered before entrance into the tank.

In demonstration No. 3, a paint job was done after testing, but the test was inappropriate and two men were overcome. The third was also overcome while attempting to rescue the first two; and the fourth with a lantern suffered the same end after using a lantern which exploded. The fifth man was not able to rescue any of the four who had collapsed.

In demonstration No. 4, a typical rescue was shown. A man who had collapsed was pulled out of a tank by a properly fitted belt and line, and prone pressure resuscitation was administered to him, along with the use of a carbon dioxide-oxygen mixture given by inhalator.

Demonstration No. 5 showed a man entering a tank with a hose mask and a properly belted line. Air was also blown into the tank to protect against explosion. At the same time, continuous testing of the air was done to prove that the atmosphere continued to be respirable.

During the interludes between these demonstrations, Mr. Gurney, of the Liberty Mutual Chemical Laboratory made several demonstrations of various chemical experiments. The first of these was putting out flames of candles in a long tube representing a tank, by fumes of carbon dioxide from dry ice.

The second laboratory demonstration was the use of 10 drops of a volatile solvent, in a specially prepared apparatus, which, after being volatilized rapidly and sparked, exploded.

The final laboratory demonstration showed the improper use of flammable paint, which actually took fire during the demonstration.

THE Session on Occupational Disease was held on October 13, with P. J. Angsten, Chairman, Illinois Industrial Commission, Chicago, as chairman. The papers were:

"The Trend of Occupational Disease Legislation," by Henry D. Sayer, Mgr. Casualty Department, Association of Casualty & Surety Executives, New York City;

"Handicaps in the Diagnosis of Occupational Diseases," by Dr. Carey P. McCord, Director, Bureau of Industrial Hygiene, Detroit Dept. of Health, Detroit; and

"The Necessity for Uniform Absenteeism Records in the Industrial Health Program," by Dr. M. H. Kronenberg, Chief, Division of Industrial Hygiene, Illinois Dept. of Health, Chicago.

Introducing the session, Chairman Angsten commented on the experience in the State of Illinois since the effective date of the Compensation Law for Occupational Disease Disability, October 1, 1936. Statistics were also given of recent experience during the past year.

Mr. Henry Sayer, in discussing "The Trend of Occupational Disease Legislation," felt that while compensation for accidental injury and occupational disease is somewhat similar, however, when we consider the basic principles we find that the two problems differ greatly, the causes and effects being dissimilar, and also that we must approach their solution in quite different ways with essential distinctions in mind.

One of these distinctions is that an accidental injury occurs at a specific time and it, therefore, is fairly easy to fix the liability under an insurance policy; frequently this is not so with occupational disease, and insurance by its very nature can only assume liabilities that have yet to arise, not those which have already accrued.

The term "accidental injury" was considered from the standpoint of definition and also as to the construction which has been put upon the meaning of these words by various court decisions.

It is not, however, so easy to define the term "occupational diseases." It is very important to emphasize that legislatures have sought to define the term, referring to occupational diseases, but in many instances only general and vague language has been used. It is also impossible to condone the legislature seeking to evade and avoid responsibility by transferring to courts and commissions the determination of questions of liability which the legislature finds too difficult for it to determine for itself. However, it is wise to support the view that the policy of coverage under the law should be determined by local legislatures in the light of local demand, and with due regard to local opinion of both labor and industry. Furthermore, the reasonable and intelligent way for industry to discharge its obligations to its workers for conditions of health is to provide for the greatest reasonable requirements for industrial hygiene and to provide compensation only for those conditions that arise from specific named diseases that are truly occupational, characteristic of, and peculiar to the processes in which the worker is engaged.

In 1935 the State of New York added to its schedule an additional item reading "any and all occupational diseases." The schedule was not repealed and the administrative provisions in the law with respect to the schedule were continued. Naturally a question arose as to whether the new classification superseded the schedule and the limitations set forth therein, or whether it was an addition to the schedule and applied only to those conditions not previously included.

As a result of this provision, the case of *Goldberg* v. *Marcy Corporation*, (251 Appellate Division, 904) becomes of great importance, and the decision in this case is particularly important to us. In commenting on this case, the Appellate Division stated that to make every disease that arose out of and in the course of employment compensable as an occupational disease would make the compensation law the equivalent of life and health insurance; that to be occupational the disease must be one which "results from the nature of the employment;" and that by nature of employment is meant conditions to which the employees of a class are subject and which attach to the occupation "a hazard which distinguishes it from the usual run of occupations,

and is in excess of the hazard attending employment in general."

Another important development recently has been the principle of limited and graduated liability of the employer for dust diseases, which has been recognized by enactment of provisions in the states of New York, Michigan, Pennsylvania and Ohio.

It is very vital that medical determination of what safe limits are in exposures, the so-called "threshold limits," be defined.

Finally, in the interests of all workers and employers, it is sound that we do not embark upon legislative policies that can lead only to enlarging the field of unemployment and to closing the door of industrial opportunity to those skilled and faithful workers who, having passed the meridian of life, are subject to those natural infirmities and ills of the flesh to which all men, in time, must bow.

Dr. Carey P. McCord, in discussing the "Handicaps in the Diagnosis of Occupational Diseases," pointed out various specific difficulties in which laymen can be of great help.

1. The necessity for the standardization of terminology and definitions. Hernia is classed as an accident in certain states and as an occupational disease in others. The definitions of occupational disease may vary from state to state. Benzol poisoning is also classed as an accident in certain jurisdictions, while in others it is thought to be a disease.

2. The use of fallacious medical histories—full acceptance of the patient's statements, especially when he is not well-informed on etiology. There has not been a sufficient amount of information developed in medical histories in reference to the work history.

3. Time factors. In instances where disease is not fully developed and tests are neglected, which if taken, would be invaluable later, a great deal is thus left undone. There is great need for highly skilled consultants in every state, particularly for the use of the general run of physicians who are not experienced. This is no fault of the medical profession, and there should be better cooperation between those in general practice and the consultants.

4. The great difficulty of finding out what a given patient works with in industry. The usual experience is that the formula is identified by a number, which gives no indication of its chemical contents; very often the foreman does not know and the superintendent is uninformed, and it is with great difficulty that it is possible to run down the chemical constituents in certain types of compounds in general use.

5. The absence of records kept at the plant. An instance was given of an elevator operator contracting silicosis in which it was impossible to figure out the etiology until it was discovered that some time before he had been exposed to a silica hazard for a period of seven and a half years.

6. The general practitioner is not provided usually with specific reference works on occupational diseases, in contrast to the specialist in this field. Incidentally, there is great need for a practical textbook on occupational diseases for the use of general practitioners.

7. New chemicals are often the source of misdiagnoses. Experimental work should obviously be done on new chemical compounds before extensive use.

There are a number of ways in which the situation may be improved:

1. Increasing the general knowledge of the general practitioner on the subject of occupational diseases; it is not expected that the general practitioner become an industrial hygienist, but he can increase his practical knowledge to considerable advantage.

2. In every industrial community and in every state which has developed industrially, there should be a group of consultants with which the general practitioner can cooperate in referring his cases.

3. Public bureaus composed of doctors, engineers and chemists, as well as other technical persons, should be equipped to work with interested persons without prejudice.

4. There should be a better disclosure of the character of substances used in industry for manufacturing purposes.

5. There is no reason for the endless bickering which has taken place at times in regard to occupational disease problems—such a situation is injurious to all and in many instances it resolves itself into being "wrong in a loud voice."

6. Physicians in general should develop a more tolerant and friendly attitude to those who are specializing in the field of occupational diseases.

Dr. Milton Kronenberg, commenting on the "Necessity for Uniform Absenteeism Records in the Industrial Health Program," believed that, based upon our previous experience with accident facts and figures, such principles should be applied to the adequate uniform reporting of absences due to occupational diseases and the analysis of the causes of these absences.

Industry must have a yardstick for the measurement of its responsibility in regard to the occurrence of loss of time and money dependent upon occupational factors.

In a series of slides it was demonstrated that in showing death rates by occupations, the rates for unskilled workers were over twice as much as those occurring in the professional groups, and also exceeded those for "all causes." The U. S. Public Health Service pneumonia study was also referred to as a guide providing control measures in such groups.

Further tabulations were illustrative of instances in which some departments have more cases than others, thus pointing out the need for further investigation. Typical forms for every employee with reference to the use of sickness records were demonstrated.

In conclusion, it was stated that uniform adequate absenteeism reports provide means for the reduction of waste by indicating where there is necessity for further investigation and probable control of the difficulties encountered.

THE Session on Health Service in Industry was held on October 14. Dr. C. D. Selby, Medical Consultant, General Motors Corporation, Detroit, and President, American Association of Industrial Physicians and Surgeons, was Chairman. The papers were:

"Industry's Part in Combating Venereal Disease," by Dr. A. E. Russell, Surgeon-in-Charge, Office of Syphilis Control in Industry, U. S. Public Health Service, Washington, D. C.;

"What Can Be Done About Fatigue?" by Dr. Harold A. Vonachen, Medical Director, Caterpillar Tractor Company, Peoria, Illinois; and

"A Surgeon's Experience with Industrial Injuries," by Dr. Harry E. Mock, Chicago.

Dr. Russell stated that venereal disease has been previously very much neglected. Impetus to interest in venereal disease has been given by the Surgeon-General and by the U. S. Public Health Service's work. The general public has thus changed its attitude and is very much more intelligent now in regard to the consideration of causes and treatment of venereal disease.

A general description of the disease itself was given, particularly with reference to its stages and the etiology. It has been estimated by actuaries that life is shortened 32 years when cases go untreated. Statistics on syphilitic births and deaths from luetic heart disease were given also. The death rate in this country exceeds that of many others, from luetic disease. The diagnosis is certain and the treatment efficacious. The economic loss to an industry is considerable through loss of efficient workers in addition to medical and hospital costs.

As a program which has been suggested by the Surgeon-General of the Public Health Service, blood tests can be done on applicants for work. If the individual is not in the infectious stage or does not show damage to the central nervous or cardiovascular systems, he may be employed if treatments are arranged for and taken. Cases should be referred to the family physician, and there should be extensive cooperative relationships worked out between the family and the plant physicians. Such a program has produced noticeable effects in industry.

Statistics quoted (on lantern slides) showed that the United States has the highest rates of many countries for the incidence of syphilis as follows: United States, 796—Great Britain, 47—Denmark, 20—Sweden, 7 (these rates are case rates per 100,000 population). The greatest number of cases occur between ages 20 and 50.

Statistics showing comparison of proper and improper treatment in Copenhagen and in the United States revealed marked dissimilarity. There was only a small percentage of improper treatment in the Copenhagen figures, while the percentage in the United States was quite large.

Discussion brought out the point that the Scandinavian plan includes free treatment, the cost borne by the government, whereas social security funds are used in this country for the same purpose. The Kahn test is a reliable one and is found to be less complicated than other serological tests.

Dr. Harold Vonachen—Speaking on "What Can be Done About Fatigue?"—considered somewhat in detail the physiological and pathological changes produced by fatigued states, after defining what fatigue is pathologically and physiologically.

A great deal of attention within recent years has been given to the atmospheric environment, and it is believed that this interferes considerably when the factors are not favorable, with heat regulation and blood supply. In this connection, humidity is the most vital air factor.

Lighting as a factor is supposed to be related to fatigue in between 5 and 10% of cases; in the constant use of the eyes there is nervous exhaustion.

Other causes for fatigue may be inability or lack of training; constant noise, producing irritability and leading to fatigue; monotony; poor posture; the various factors in home environment, including loss of sleep, the use of alcohol and other items probably more responsible for "blue Monday" than industrial environment.

The products of fatigue are ill-health and decreased production, and the employer must do his part in providing an environment which decreases the chances of fatigue production; the employee must also adapt himself to his environment.

In conclusion, it was stated that with the 40-hour week, fatigue is not a practical problem in industry, if the employer and the employee both do their parts.

Dr. Harry Mock, in commenting upon "A Surgeon's Experience with Industrial Injuries," stated that during a 30-year period in surgical practice there has been considerable progress; 30 years ago there was no attempt to treat or prevent serious injuries, but through various changes in economic and social attitudes, with the coming of certain kinds of legislation, the preventive principle has flowered and the development of medical service and first aid has reached the highest standards. The rehabilitation experience in the army has been adapted to civil life. The development of accident commissions has made it possible that the injured worker now receives better surgical treatment than the private citizen. This has been augmented by the rehabilitation and training courses established for the seriously injured and handicapped. As an adjunct to surgery, physical therapy and occupational therapy have reached a high stage of development. It was necessary, however, to control the exploitation which occurred with reference to physical therapy and, as a potent factor in this control, the organization of the Council on Physical Therapy by the American Medical Association in 1923 has made it possible for physical therapy to now be recognized as a specialty.

Various changes in attitudes have come about during the past 30 years. Among them: shock

should be treated first—more intelligent use of blood transfusion—the proper control of emergency operations. As a notable example, operations for skull fractures have decreased from 36 to 10%.

Among the other changes and attitudes and the progress made in this field are the overcoming of permanent defects by reconstructive surgery and, finally, the development of traumatic surgery as a real specialty.

Collapse of Glass Eyes

—In the Orbit—
—With Review of the Literature, and Report of Case—

WILLIAM M. HAYES, M.D.,
Hamilton, Ohio

ODD, but true, in reviewing the literature on the breaking of glass eyes while being worn, it is under the title "Explosion of Glass Eyes in the Orbit" with the exception of one reporting, and that is under the title "Spontaneous Rupture of Glass Eye in Situ."

A search was made through the list of industrial hazards, but no mention is given of individuals wearing glass eyes being a hazard in the industrial field. It is my opinion that they should be classed as such and catalogued.

Various manufacturers of glass eyes were written to about the making of them, why they broke in the orbit, and what the pressure was within the cavity of the sealed eye. On this entire subject they were rather sphinx-like—no reply being received from them even when explaining in the communication why the information was requested and to what use it was going to be put.

Several large optical appliance companies were interviewed about the breaking of glass eyes in the orbit. They did not attempt to give any information or reason for the breaking, but they knew it occurred. One of them stated that one man in particular has had quite a number of them break while being worn. This man is employed as a waiter and when going from the dining room to the kitchen, which is very hot, especially in the summer, the eye would explode. To prevent this he removes the eye when going to and fro. The eyes were always broken in at the concave portion of the posterior part of the eye, and the piece or pieces broken out could be seen within the cavity of the glass eye. He also informed me that he had artificial eyes to break on a tray in a display case when the sun's rays struck them on a hot summer day for any length of time. The percentage was very small, but it did happen. The concave posterior portion of the eye was the part that was always broken.

Rochester,[1] under the title "Spontaneous Explosion of Snellin Improved Artificial Eyes," does not report any individual cases but the breaking of artificial eyes in the orbit was called to his attention by a fellow colleague. Rochester had never heard or nor was he conscious of such a happening prior to this. He collected some cases and reviewed the literature. He interviewed some makers of artificial eyes and was told that the air-sealed cavity within the glass eye was less than one atmosphere. No sound reason was given why the breaking was called an explosion. He was told that some of the eyes broke while on the shelves, and that they broke on extremely hot or cold days; also that the makers of glass eyes were going to look into the cause of the breaking and they would like to do something to prevent the occurrence. He mentions that the orbital lining secretions through their chemical action had some effect on the glass eyes. This hardly goes hand in hand, as glass eyes break while on shelves. Rochester was so intrigued with the subject that he brought it up before the Chicago Ophthalmological Society, November 20, 1916.

Metz[2] reports on the spontaneous explosion of artificial eyes, his case being that of a young man who, while walking along, thought someone had shot him in the artificial eye. The breaking of the eye went off like the report of a gun. The patient had trouble in removing the eye. This was followed with quite a lot of bleeding. The back portion of the eye was broken and the piece was in the cavity of the artificial eye.

Weilder[3] reports one case under the heading of explosion of the Snellin eye in the orbit. The date of occurrence was August 1, 1916. This happened to a housewife who had been wearing artificial eyes (left) for 10 years. The eye that broke had been in use for only one year. She had been cooking over a hot stove and walked to the door for fresh air when the eye broke. The breaking was associated with much shock. There was some difficulty in removing the eye on account of the suction, but she finally removed it herself. The posterior portion of the eye was broken and the pieces had fallen into the socket. The eye that broke had been made to order.

Urbanek[4] presented a case of an explosion of an artificial eye in the right orbit, before the Vienna Ophthalmological Society, February 18, 1924, First Service of the Eye Clinic, his case being a woman 53 years of age. She had had tuberculosis of the right eye, and the eye was removed when she was 17 years of age. A glass eye was put in. One morning in the early part of February, 1924, she stooped down and in doing so something had struck her in the region of the right temple. This was followed by pain in the right orbit, associated with a flow of tears, and the tears were bloody. In vain she had sought to remove the artificial eye. She was brought to the clinic shortly after in the ambulance. While in the clinic she was seen by Professor Meller, and he pointed out to us the possibility of a spontaneous explosion of an artificial eye within the orbit. He separated the lids and he had much difficulty in removing the artificial eye. The back portion of the eye was found to have a piece broken out of it. The opening measured 10 mm. long and 5 mm. wide. Urbanek, in presenting this case, also referred to Kayser, of

Stuttgart, who had a similar case in 1918 of an explosion of an artificial eye in the orbit. Difficulty was had in removing the eye, and Kayser mentioned the importance of having a lever made to remove any eye in the future. Urbanek, in the case he reports, does not make any reference to the piece that was broken out in the back of the glass eye, that is, if he looked for it, and if located what was the location. He does not state how long the eye had been in use, or whether the eye showed any erosions. In fact, he makes no mention of the secretions of the orbit.

Lewis[5] records the explosion of an eye in a mechanic. He had been wearing glass eyes for many years. The glass eye that broke had been in use for about six months and the breaking occurred while he was sitting in a powerhouse. Lewis states that he does not know if the explosion was due to positive or negative pressure within the glass eye, or pressure from the surrounding orbital tissues upon the glass eye. The eye was removed with difficulty on account of the suction which held a tuft of the conjunctival tissue fast in the aperture of the glass eye. The posterior surface was broken. After removal of the glass eye there was much laceration and bleeding. The piece that was broken out was found within the cavity of the glass eye. There was no erosion, as commonly seen after long usage, and the eye was found smooth.

McKee[6] cites three cases but does not attempt to give any cause for the breaking. His recordings are under the heading of "Explosions of Artificial Eyes in the Orbit."

Case 1. Male. While at work in 1923, the right eye exploded and he was shocked. The eye was completely demolished and the pieces were found in the orbit.

Case 2. Female. She had three eyes to break within a few months in 1923. This case was a young lady well up in the strata of life, and she had gone to the largest centers in America to make purchases of artificial eyes.

Case 3. Male. The accident occurred in 1924. When the eye broke he stated that he felt as though his brains had been knocked out. McKee does not state under what circumstances the breaking of the eyes occurred.

Dunphy[7] reports one case of explosion of a glass eye in a young man 20 years of age. He was sitting on a screened porch at the time of the breaking, and had worn the eye for months when it exploded. Dunphy had some difficulty in removing the glass eye. There was laceration of the conjunctiva and considerable hemorrhage. The back of the eye was broken. The broken pieces were removed from the cavity of the glass eye.

Collado[8] reports a very interesting case, and goes much into detail. He was called to see a woman 41 years of age. She had lost the sight of the left eye when six years of age, due to an accident. The eye was removed. She had been wearing glass eyes for the past 15 years. One glass eye had been in use for eight years without its removal from the socket. The eye that ruptured had been in constant use for two years without ever being removed. Collado does not state why the eyes were worn constantly and not removed for cleansing. This woman, he remarks, has a malignancy of the uterus and is receiving radium treatments. She was about her regular house work when she felt what she thought was an explosion in the glass eye. The patient, when visited, was in a semiconscious state and in severe pain. Cocain solution (strength not given) was dropped around the glass eye to find its way to the soft parts, and then he attempted its removal. The patient complained of great pain. Novocain solution 2% was now injected into the surrounding parts. The eye was firm in the socket and could not be budged and more solution was injected. In all, three hours was spent in removing the eye. Finally a glass rod was used as a lever and the eye was pried out. All this was associated with great pain. It was noted that the eye was being held back in the eye socket as if some force was holding it. After removing the eye there was much hemorrhage. The glass eye was washed and it was found that a piece was broken out in the back of the eye and that the broken piece was found within the cavity of the glass eye. He was of the opinion that a metastatic process had taken place in the soft tissues in the back of the orbit and the tumor mass pressing on the back portion of the eye had broken it in, and the cause of the anchorage of the glass eye in the socket was due to the tumor mass forced into the hole in the back portion of the eye where the piece had broken out. He makes mention that he did not explore to see if there was a tumor mass in the orbit. He considered this a curious and rare case, and that perhaps no one else had experienced a similar case, and thought that he should publish it. He showed two photographs of the broken glass eye, one where the piece had broken out of the posterior surface. In reporting his case he does not make any mention if the eye showed any erosions or roughness from the secretions. This is an important point, as the eye had been worn constantly for two years without its removal.

Queries and Minor Notes[9] *Question:* What is the cause of explosion of artificial eyes while being worn? The answer is quoted in full: "From time to time there appears in the literature the account of an explosion of an artificial eye without apparent cause, while being worn. All in all, less than a dozen such incidents have been reported. It is believed such explosions result from the sudden admission of air to the interior of the eye. In the process of manufacture, the air within the shell of the phosthesis is expelled by the heat to which the glass is subjected while being formed. Ordinarily, the vacuum thus produced is maintained, but in some persons there is enough secretion from the socket to cause a gradual erosion of the shell. The erosion may hit a thin spot in the shell and, when the external air pressure is greater than the strength and resistance of the glass at this area, the wall of the shell is forcibly ruptured. Usually there is no explosion, but under certain conditions that are not fully understood the sudden advent of

the air under ordinary atmospheric pressure is sufficient to cause the explosion."

REPORT OF CASE:

C.A.W. White male. Age 36. General health very good. The left eye was enucleated January 18, 1937, due to an injury, by Dr. H. J. Baker, Hamilton, Ohio. He started using an artificial eye about the middle of March, 1937. The eye had been in use only for two months. The eye was removed frequently for cleansing. May 17, 1937, he came from a cool place and sat out in the sun to lunch (noon-time). He was sitting in the sun without a hat for about 15 minutes. He stated that he felt as if something had struck him in the artificial eye with great force, and a marked report was made that sounded to him like an explosion. He tried to remove the eye and it felt as if something was holding it back, like a suction in the back portion of the glass eye. Finally he removed the eye, which was followed by blood running down his face. When the eye broke he felt dazed for a few moments. I saw him about 10 minutes after the breaking of the eye. He was rather unsteady and insisted that something had struck him in the artificial eye. At this time there was considerable hemorrhage. He was placed upon a cot and finally the bleeding stopped and he regained his poise. The artificial eye was examined and a small piece was found to have broken out in the back portion of the eye, the aperture measuring a quarter of an inch in length (6 mm.) and an eighth of an inch in width (3 mm.) Fig. 1. The

Fig. 1.

Fig. 2.

socket of the eye was examined for the piece that had broken out, but it could not be found. The artificial eye was washed and cleansed, and the broken piece was then found within the cavity of the glass eye. The eye was smooth and showed no erosions. Since the breaking of this eye he has worn another, removing it only for cleansing.

THE writer feels that the cause of the breaking of artificial eyes should be cleared up, either while being worn or on the shelves; whether the eye explodes or collapses. If the eye breaks there would be a report similar to an explosion; is this report due to the eye exploding or collapsing? This would depend on the pressure within the cavity of the glass eye. The glass eye being in the socket and surrounded by a bone wall, when breaking one can appreciate the recording on the auditory apparatus; whether it is an explosion or collapse you have the same recording. If an incandescent lamp globe is hot or cold, and still remains well under one atmosphere when breaking by casting it against some object, a marked report is made as if an explosion had occurred. The sound is due to an inrush of air to equal the outside atmospheric pressure. If the air within the globe be two atmospheres, whether the globe be hot or cold when breaking it, you have a recording similar to an explosion, the air rushing out. If the pressure is the same within and without, upon breaking the globe there is no report other than the globe being struck. Incandescent lamp globes are so fabricated and of such strength that the pressures are taken care of whether the globe is hot or cold, and they do not explode or collapse under normal conditions.

Four glass eyes in good condition, some broken glass eyes and one glass eye that was broken while being worn were obtained from an optical appliance company. The eye that was broken while being worn was broken in the posterior concave portion and the piece that was broken out was within the cavity of the glass eye. All of this material was sent to a very responsible laboratory so that the construction of glass eyes could be seen. A special request was made for the pressures within the four glass eyes sent. The laboratory reported as follows: Two of the four eyes were examined for internal pressures. One had one-half and the other had one-third of an atmosphere.

The optical company from whom this material was obtained explained that the eyes were made and blown at a white heat. A glass eye about 80% complete (Fig. 2) shows the globular mass with its long stem four inches in length. The stem has a capillary opening in it leading from the cavity of the globe to the outside air. The bulb portion where the stem is attached is brought to a white heat, the stem is now pushed forward toward the bulb making the concavity of the back portion of the eye. The closure is made with the glass close to its melting point with an atmospheric pressure inside the eye by twisting off the stem. When the eye cools off, or at body temperature, the pressure within the cavity of the glass eye is equal to about one-half or one-third of an atmosphere. This was proved by the laboratory that examined two of the four eyes sent for their internal pressure.

If a cross-section is made of an artificial glass eye it will be seen that about 70% of the material is in the anterior half and the other 30% is in the posterior half. The anterior half needs protection, hence about 70% of the material is in this portion of the eye. The posterior half is frail and thin, and being concealed well back in the socket needs no protection. It would seem that where the stem is twisted off at the time of closure would be the weak point. All the eyes that break do so in the posterior half in the concave portion, whether in the orbit or on the shelves. Glass eyes are made by hand and they are bound to vary. Only a very small percentage break, but there should be some way even to prevent this small percentage.

In the case herein reported and the collected cases it will be noted that the posterior concave

portion of the eye is the part that is always broken. Trouble is encountered in removing the eye due to suction, the exception being where the entire back portion of the glass eye is destroyed. The hemorrhage is more marked after removal of the glass eye. The piece that is broken out is found within the cavity of the glass eye, except where the piece or pieces are adhered to the soft parts when removing the glass eye.

Since the manufacturers of artificial glass eyes would not give any information as to their fabrication, one of the outstanding manufacturers of incandescent lamps was written to and asked if they could throw some light on the manufacture of glass eyes and why they broke, also what remedy or remedies could be offered to prevent the breaking.

The Executive Engineer replied that I had proved quite definitely that the failure of the glass eye is a collapse and not an explosion. He stated that they were not familiar with the process of fabricating glass eyes, but assumed that the closure is made with the glass close to its melting point and with atmospheric pressure inside. If this is the case, then it is to be expected that the eye at body temperature would have an internal pressure of only about one-third of an atmosphere.

In his letter he stated that the following three remedies suggested themselves:

One would be to fill the internal cavity, when the glass is hot, at an absolute pressure of two atmospheres, that is, one atmosphere higher than outside pressure. This would mean at body temperature the internal pressure would be approximately one atmosphere, so that internal and outside pressures would be balanced.

The second measure, which perhaps is already employed, and which certainly should be if it is not, is to examine each eye carefully with a polariscope to detect strains and to reject all eyes which show strain.

The third measure would be to use stronger glass, if possible, than is used at present. We do not know what glass is now used, but some glasses, such as the borosilicate glasses, of which pyrex is an example, are mechanically much stronger than the ordinary lead or lime glasses.

From the foregoing, the cause of the eye breaking is a collapse. The breaking occurs during hot weather, working in places of extreme heat, or coming suddenly from a place that is cold to one of warmth. The heat causes the glass eye to expand and be ironed out, especially the concave posterior portion which is thin and frail, the frailest part being where the stem is twisted off to make the closure of the eye. The pressure within the eye might rise slightly above the one-half or one-third of an atmosphere. (Probably the eyes that break are the ones that are near the vacuum point.) The pressure around the glass eye is one atmosphere. Here you have a greater pressure on the outside of the eye than within the cavity of the eye. The eye is thin in the concave posterior portion and expansion due to heat adds to its frailness and cannot withstand the outside pressure; hence the eye collapses—*it does not explode*. To prove that the eye collapses, there is a suction of the soft parts within the cavity of the eye where the piece has broken out. Difficulty is had in removing the eye due to the suction and anchorage. The piece that is broken out is found within the cavity of the glass eye. (The only exception is where the eye is entirely destroyed or where the piece or pieces adhere to the soft parts when removing the eye.) With the collapse, there is a rushing in of air that sounds, to the one experiencing the breaking, as if the eye exploded. It is unfortunate that all of the recordings of the cases do not give the conditions under which the eyes broke. The eyes that break are frail to begin with, and cannot withstand the external pressure under conditions due to heat. It is indeed very fortunate that only a small percentage of glass eyes break. From the literature, not very much importance is placed on the secretions from the orbital tissues.

Lewis[5] observed that the eye was smooth and showed no roughness. In my case the eye showed no roughness and was smooth throughout, just as if it had not been in use.

Collado[8] makes no mention of the eye being rough, although it was in constant use for two years and not even removed from the socket for cleansing.

McKee[6] in his case No. 2, had three eyes to break within three months.

All the eyes referred to that broke while in the orbit had not been in use for a long period of time, not over one year, the only exception being the case of Collado's.

Summary and Conclusions: The eye collapses and does not explode. The report made is due to an inrush of air within the cavity of the eye when breaking. The posterior concave portion is the part of the eye that gives way, as it is the thinnest and becomes ironed out, due to expansion because of heat. The external pressure is greater than the internal pressure and causes the eye to collapse. The eye is removed from the orbit with difficulty, due to the suction. The piece or pieces that are broken out are found within the cavity of the glass eye, with the exception of where they adhere to the soft parts on removing the glass eye.

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Evidences of Inhibitory Action of Different Minerals upon Silica

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A SERIES of experimental and industrial plant studies has indicated that the amount of silicosis developing in animals and men is not necessarily proportional to the quantity of free silica in the rock creating the dust to which they are exposed.* In the case of dusts containing other minerals as well as free silica two sets of factors operate to retard the development of silicosis. The first are physical factors which govern the size and the dispersion of different kinds of particles suspended in the atmosphere. They tend to bring about a reduction in the amount of inhalable silica. In the second category are physico-chemical phenomena which tend to retard the usual effects of the silica particles after they have entered the body. Their action may be a result of the deposition of a more or less impervious coating upon the surface of each silica grain so that effective contact with the body fluids is interrupted.

The influence of the *external atmospheric factors* has been intensively studied in experimental dusting rooms 8 x 8 x 8 feet in diameter. In one corner of each is a hopper provided with a rotating paddle to agitate different, finely ground minerals and set up dust clouds. Around three walls of these rooms are animal cages with closed tops and backs but open fronts and sides covered by ¼-inch mesh wire screening. In the descriptions which follow, the terms "air-borne dust" and "breathing zone" refer to the interior of these cages. Repeated impinger counts under light field illumination have demonstrated that the concentration of the very fine air-borne particles is essentially the same in the inside of all of the cages regardless of the height above the floor. Outside the cages the particles are considerably larger in size, the average concentration is from three to six times as great and increases as the sampling point approaches the floor.

On experimenting with an apparently fine *ferruginous chert*, which on analysis contained 54.6% of free silica it was found that the air-borne dust yielded only 10.47% SiO_2. Analysis of the lungs of guinea pigs exposed for 1 10/12 years to concentrations averaging 465 million particles per cubic foot (16,430 per cc.) of air revealed only 3.3% SiO_2 in the ash. Investigation demonstrated that most of the finer components of the ground rock were iron while the silica particles were appreciably larger. Apparently many of the latter settled out of the air before they could float into the interior of the cages.

A second lot of the same chert was ground for a prolonged period so that practically all of the particles were 3μ or less in diameter. Analysis revealed 67.5% silica.

On agitating this extremely fine material in the same manner there was still a marked reduction in the silica content of the dust at the breathing zone. Impinger samples revealed only 41% silica. In the ash of lungs from animals exposed for 18 to 24 months there was only 16 to 17%. In this case the relative size of the silica and the iron particles could not altogether account for the reduction.

Artificial mixtures of *calcined gypsum and quartz*, each previously ground so that only a small proportion of the particles were greater than 3μ in diameter, were also tested in the same manner and again it was found that there was a progressive decrease in the proportion of silica from the agitating hopper to the animal's lungs. Experimenting with a mixture of equal parts of the two minerals demonstrated a reduction from 49.7% SiO_2 in the parent material to 29.6% in atmosphere. With a mixture composed of two parts of gypsum and one part of quartz the percentages of SiO_2 were 31.4% in the parent mix, 17.1% in the air-floating dust and 15 to 16% in the lung ash. By allowing dust to settle on slides placed inside the cages it was demonstrated that much of the air-floating material had flocculated to form clumps 30 to 40μ in diameter. In a mixture of this character, composed of minerals having opposite electrostatic charges, such flocculation can hardly be prevented. The weight of these clumps caused many of them to settle out of the atmosphere and their size probably prevented many of them from entering the nostrils of guinea pigs exposed to the dust.

Chart 1 shows that less dust is actually inhaled from an atmosphere averaging 465 million particles per cubic foot (16,430 per cc.) of gypsum and quartz (2:1) than from one averaging only 100 million particles per cubic foot (3,534 per cc.) of pure quartz. It also shows that the proportion of silica in the ash of the lungs is less after varying periods of exposure than in control animals exposed to *theoretically* equivalent concentrations of quartz in pure form. Attempts to measure the number of quartz particles by actual count after dissolving the gypsum have thus far failed for technical reasons. Probably the number of silica particles in the atmosphere is much less than the computed values.

Pathologic reaction in the lungs of animals exposed to high concentrations of mixed dusts of varying silica content have been very different from those produced by the same or lesser quantities of pure quartz. The inhalation of pure silica produces characteristic nodular fibrosis in the lungs of many species of animals. Within wide limits there is a reciprocal relationship between the atmospheric concentration of the dust and the duration of the exposure. In any series of animals being exposed to pure silica there is a regular and uniform progression of the amount and character of the reaction; once a silicotic type of

* From the Saranac Laboratory for the Study of Tuberculosis of the Edward L. Trudeau Foundation, Saranac Lake, New York. Presented before the New York State Society of Industrial Medicine, Albany, N. Y., November 3, 1938.

change has made its appearance it is manifested with increasing intensity in every succeeding member of the series.

Daily eight-hour exposures to atmospheres containing 380 million particles per cubic foot ("p.p.c.f.") (13,430 per cc.) of *hematite* contaminated with 6% of silica for 42 months has produced only focal areas of pneumonitis without fibrosis. Similar exposures to 345 million p.p.c.f. (12,190 per cc.) of *ferruginous chert* (50% SiO_2) produces no more reaction than hematite in a period of two years. After three years nodular reactions developed in the lungs of some but not all of the animals; these lesions were of a cellular rather than a fibrous part of quartz the average atmospheric concentration was 465 million p.p.c.f. (16,430 per cc.). After 18 months of eight-hour daily exposures pulmonary reaction could only be seen in highly magnified sections of the tissues. After two years patches of pneumonitis had developed in some of the animals. By 29 months a few nodules of modified silicotic type were detected in the lungs of occasional guinea pigs; most of them continued to show only the non-specific pneumonitis.

Experience with a group of human gypsum workers who had been exposed for periods varying from 10 to 35 years to excessive concentrations of dust containing a theoretically hazardous pro-

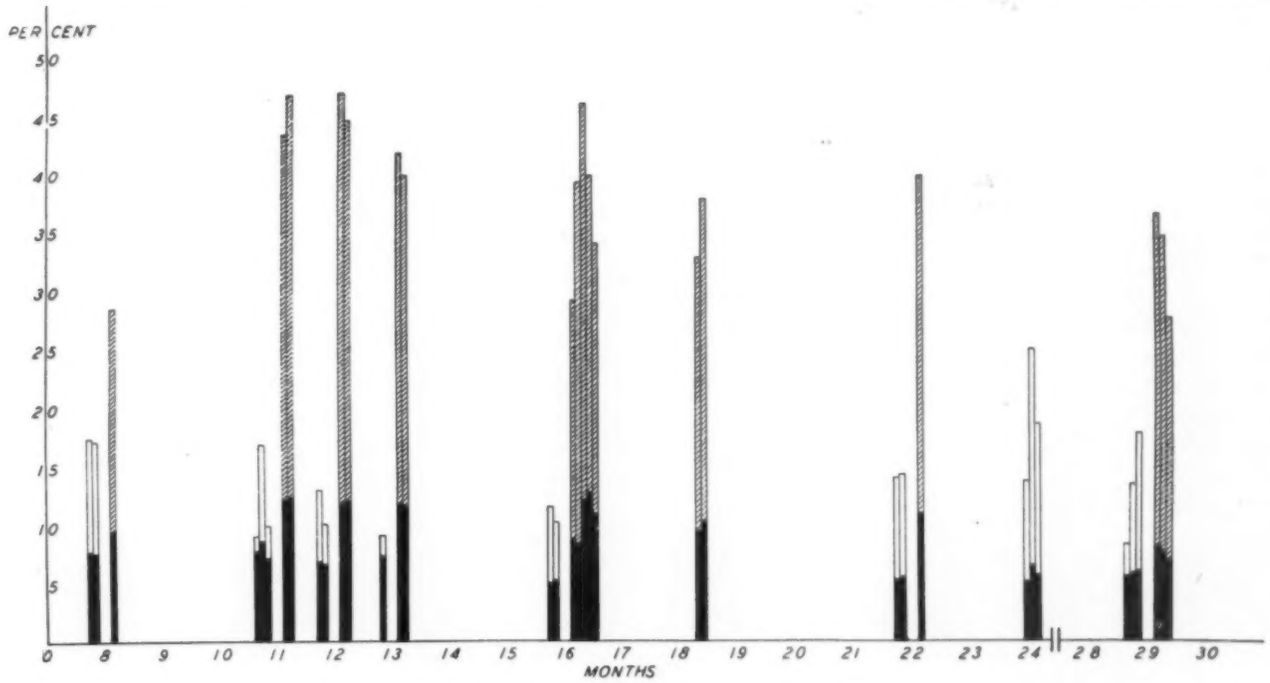

Chart I. Chemical Analyses of Lung Ash

The total height of each column represents the percent of ash in dry lung. The upper portions, either plain or closs-hatched, represent the percent of silica in such ash. The shorter columns with plain tops indicate the findings in guinea pigs exposed to the mixture of two parts of gypsum and one part of quartz. The taller columns with the cross-hatched tops represent the corresponding findings in guinea pigs exposed to pure quartz.

character. *Barre granite* (35% SiO_2) in concentrations averaging 550 million p.p.c.f. (19,430 per cc.) has caused no more reaction than hematite after an exposure of two and one-third years.

Artificial mixtures of gypsum and quartz have provoked similarly atypical responses. A mixture of equal parts of the two minerals producing an atmospheric dust concentration of 318 million p.p.c.f. (11,240 per cc.) caused nothing but pneumonitis without nodule formation or fibrosis in the lungs during an exposure of 24 months. Among 13 animals allowed to survive the exposure in a normal atmosphere from one to six months four showed occasional nodules of silicosis. In controls exposed to pure silica dust of a concentration of 100 million p.p.c.f., (3,534 per cc.) approximately the theoretical silica content of this mixture, nodular fibrosis developed in 18 months. With the mixture composed of two parts of gypsum and one portion of free silica revealed evidence of similar protective action. Roentgenograms of their chests failed to disclose any evidence of silicosis; they had no symptoms and none of them could be classified as suffering from pneumoconiosis of any type. One man, similarly exposed, who died of other causes was autopsied. His lungs revealed a very insignificant amount of pigmentation in the perilymphatic areolar tissue but not the slightest suggestion of silicosis. He had inhaled some silica, however, for a microscopic collection of silicotic nodules was discovered in one of his tracheobronchial lymph nodes (seven other sections of the nodes showed no such lesions). This case affords ample confirmation of the reduced silica intake and also constitutes a perfect example of physiologic disposal of small amounts of inhaled silica with deposition in areas where it can do the subject no harm.

THESE experimental and clinical experiences all demonstrate that exposure to silica in combination with other minerals does not necessarily result in silicosis. When the proportion of silica in a mixed dust is low or when the other substances are particularly effective for one reason or another silicosis may never develop. Larger quantities of silica associated with less effective inhibitors seem to produce reaction of a modified type after surprisingly long periods of exposure. In experimental animals the striking feature of the delayed reactions is the irregularity of their occurrence. During the periods of observation thus far completed, modified silicosis has only developed in a small proportion of the animals exposed—never more than 30%. Such a sporadic incidence is quite different from the uniform involvement of animals inhaling pure silica. It has been assumed that the lack of reaction is due in large part to the exclusion of silica from the lungs. To explain variations in individual "susceptibility" one might postulate differences in upper respiratory protection although actual proof of such differences has never been demonstrated in animals.

To account for the prolonged period necessary to produce silicosis in the guinea pigs which did respond, it had been assumed that only after such long exposures had effective quantities of silica entered the lungs. However, this is apparently not the whole story. Even after different siliceous mixtures have been deliberately brought into contact with the tissues by injection they do not provoke reaction proportional to their content of silica.

Intravenous injections of rabbits have demonstrated beyond the possibility of doubt that pure crystalline and cryptocrystalline silica invariably produces progressive fibrosis of a characteristic nodular form.[1] Some, but not all, species of amorphous free silica have a similar effect. The rate of reaction is directly proportional to the quantity of particles injected and the period of contact with the tissues. One gram or 0.5 gm. of particles 1 to 3μ in diameter causes mature fibrosis in a year's time and even 0.05 gm. has a similar effect in two years. It has been shown further that the rate and severity of such reaction is inversely proportional to the size of the silica particles,[2] a result which indicates that tissue response is determined by the amount of mineral surface in contact with the body fluids.

Similar injections have demonstrated that combined silica in the form of silicates is comparatively inert.[3] Particles of most of the silicates are ingested by phagocytes and remain within the tissues for indefinite periods without producing further cellular response. A few species of talc, mica and clay have excited moderate degrees of chronic inflammation characterized by proliferation of mononuclear cells with or without lymphocytic infiltrations but during periods of a year or more none of them have caused fibrosis. One silicate, beryl, was toxic and killed animals into whose veins is was injected.

Particles of non-siliceous minerals like iron, diamond, aluminum oxide were also inert. Regardless of their hardness or sharpness they have uniformly failed to cause any other reaction than that of simple phagocytosis.

Natural mixtures of free silica with either silicates or non-siliceous minerals have not been irritating in proportion to their silica content. The reactions to the injection of one gram of particles, 3μ or less in diameter, of the following mixtures are illustrative:

Hematite containing 6% silica has caused only phagocytosis during a two-year period.

Anthracite coal contaminated with 10.13% silica was equally inert.

Crude fluorite mixed with 10.39% quartz caused a limited amount of chronic inflammation but no fibrosis in 15 months.

Granite, in which about 35% of quartz is combined with feldspars, micas and other minerals, provoked only microscopic foci of proliferation in 15 months. When the usual dose was tripled so that a full gram of quartz was injected there was no corresponding increase in the amount or character of the tissue changes. However, with each of these doses the time during which the mineral particles remained in contact with the body seemed to be much more important than the quantity injected. Neither dose produced fibrosis during the period of observation but each of them caused cellular proliferation which began to increase in severity after an initial quiescent period of about a year.

Ferruginous chert composed of 50% free silica and 50% iron behaved in a similar manner. The usual dose of one gram of particles containing 0.5 gm. of silica caused a little localized fibrosis in one year. Compared with the effect of 0.5 gm. of pure silica this response was quite insignificant. On doubling the dose of injected chert particles so that a full gram of silica was introduced the inhibitory effects of the iron were apparently overcome. Fibrosis of a modified type developed in one year.

South African gold mine dust containing 70% free silica did not produce quite as much fibrosis as pure quartz and the appearance of such reaction was somewhat delayed.

The results of these controlled injection tests with carefully analyzed mixtures of silica and other minerals indicates that there are inhibitory effects which manifest themselves inside of the body. Their effect is to delay interaction between silica particles and the body cells. In mixtures containing comparatively small proportions of free silica the inhibition may be so complete that no silicosis will ever develop. This supposition could of course only be verified after very long periods of observation but the complete lack of progression during a year or two makes it seem improbable that any further change would ever occur.

It is surmised that these inhibitory effects are due to coating of the surface of the silica particles with other minerals. Such coating could be either chemical or physical in character. To test this

theory Dworski and Delahant, of the Saranac Laboratory, performed a number of unpublished experiments. Mixtures of fine quartz and animal charcoal have been prepared with the idea that any dissolved silica would be adsorbed by the charcoal so that it could not act upon the tissue. Injection of this mixture produced silicosis without suggestion of inhibition. Quartz particles were immersed in a solution of colloidal iron in the hope that their surfaces would be coated in the same manner as those used by Kettle.[3] Injection tests failed to elicit evidence of protective action. Substitution of ferric hydroxide gave more promising results. Nodules formed but they were cellular in character and in four months time they did not even approximate the early fibrosis of control animals injected with the same quantity of pure quartz. Aluminum hydroxide gave still better protection; there was no reaction except phagocytosis after a whole year's contact with the tissues. Then the reports of Denny, Robson and Irwin,[4] appeared demonstrating that metallic aluminum effectively inhibited the action of quartz on the body. Their experiments were repeated in modified form and an effect comparable to that of the ferric hydroxide was obtained. At the present time these experiments are being repeated with equivalent quantities of the various inhibitor substances and with longer observation periods to determine whether the protection is absolute. While it seems quite definite that the silicotic reaction has been inhibited it still is impossible to define the mechanisms. Chemical and petrographic studies now in progress may solve this perplexing problem.

The evidences of inhibitor action are sufficiently pronounced so that there is little reason to suspect their validity. The significance of inhibitor action for human silicosis is not so clearly defined. Presumably it accounts for the variation in length of exposure necessary to produce silicosis in different industries. It explains certain hitherto puzzling absences of silicosis in men exposed to theoretically hazardous concentrations of silica such as those mentioned in one department of the gypsum industry and such as are occasionally discovered in the "raw end" of cement plants. The principles that have been discussed may help to clarify the moot question of "individual susceptibility" for, on exposure to mixed dusts, groups of animals respond like human beings. Only a small proportion of them develop silicosis instead of practically uniform involvement as in the case in groups exposed to pure silica. In the writer's opinion knowledge of inhibitor action is not yet sufficiently clarified to attempt to employ such substances in prophylaxis. Although better appreciation of these principles may lead to modification of existing codes, reduction of atmospheric dust must still be the major objective.

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Nomenclature in Industrial Health

THE Council on Industrial Health has from its inception considered that one of the first problems to which it might profitably give attention is nomenclature in industrial health.* A committee of the Council was appointed to study the problems from a broad point of view and to prepare the following preliminary statement:

The language of industrial health is at present incapable of full expression within the strict confines of scientific terminology. It has been greatly affected by the particular environment of the worker and his special social relationships. For the most part the usages and idioms of industrial health have derived from the authority of court decisions, legislation and administration practices, the pronouncements of industrial organizations and of medical and nonmedical technical committees, as well as from the publications in the field. Variation in source and derivation has resulted in wide confusion. The general medical profession, therefore, needs to have available an analysis of the common terms used in industrial medical practice and to arrive at a clear understanding and a common acceptance of their meaning.

Any investigation which has for its purpose the inauguration of an industrial hygiene program must obtain accurate morbidity and mortality statistics. Frequently such statistical information is unavailable or is reduced in value through lack of adherence to uniform terms. Dictionaries and encyclopedias have supplied some assistance in understanding industrial medical terminology but, on the whole, there is little to which the medical profession can turn at the present time for standard definitions of terms used in industrial health. The Council on Industrial Health, therefore, proposes to publish a compendium in which the frequently used terms of industrial medical practice will be defined and explained. It will be necessary to include explanations of certain expressions in fields of activity closely associated with industrial medicine. It is proposed that each term listed be provided with a brief and authoritative explanation. The ambiguities and perplexities of contemporary language in the field of industrial health will, as far as possible, be avoided. The compendium will not be a dictionary of terms in the ordinary sense or provide encyclopedic information, nor will its activity in any way dupli-

* *J.A.M.A.*, December 3, 1938.

cate or conflict with the work of the American Medical Association's Standard Classified Nomenclature of Disease. It is hoped this compendium will serve a useful purpose to the general medical profession, acceptable to it as a first step toward the introduction of some measure of uniformity in the confusing terminology of today.

"March Foot"

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"MARCH FOOT" may be defined as a peculiar condition affecting a metatarsal bone which usually leads to spontaneous fracture.* Synonyms are: Marching fracture; pied forcé; Deutschlander's disease; Fussgeschwulst. The earliest reference to it is credited to Breithaupt,[1] a Prussian military surgeon, who, in 1855, described a swollen condition of the foot affecting certain of the soldiers and which he called "syndesmitis metatarsea." Weissbach,[2] in 1877, made a similar observation, but neither of these men was certain of the pathology. Panzat,[3] in 1887, reported the condition and described the pathology as an "osteoplastic periostitis." Paulet,[4] in 1888, described what he called a "rheumatoid osteoperiostitis" of the metatarsals in soldiers, and again Martin,[5] 1891, enlarged upon "rheumatoid periostitis" in the marching feet. It remained, however, for Busquet,[6] in 1897, to have the first suspicion that fracture of a metatarsal was the underlying cause of the swelling and periosteal thickening which occurred in the soldiers' feet. Apparently none of the previous authors had considered fracture.

With the advent of the Roentgen ray, it was possible to study the condition accurately, and in 1897 Stechow[7] was able for the first time to demonstrate a fracture of a metatarsal as the cause of the condition which we have come to call "march foot." Being interested in this condition, which lent itself well to study with the x-rays, Stechow collected 36 cases. These he reported at the International Congress in Madrid, April, 1898, and showed x-ray plates of the same. It is interesting to note that of these first reported cases 12 did not show a fracture on the x-ray plate! (This observation has subsequently been made by other investigators and has led to a considerable amount of speculation as to the exact nature of the process.) Schulte,[8] in 1897, shortly after Stechow's report, studied and reported 53 similar cases of "march foot." Kirchner,[9] 1898-1899, next reported a series of 82 cases in which he found the condition in several civilians as well as in soldiers. On several points all of these early authors were agreed, namely that the condition usually developed after long marches especially when made under full equipment with heavy packs, also that it occurred more frequently in the new recruits. Some of the cases, however, followed athletic events, but direct trauma was fairly well ruled out. In these first three series by Stechow, Schulte and Kirchner, totaling 181 cases, no fracture was found in the first metatarsal and only one in the fifth metatarsal. Fractures of the second and third predominated, while those of the fourth were much less frequent.

In 1899 and 1900 Thille[10] reported 33 cases of disturbance of the metatarsals in which there were 14 positive fractures "due to indirect force." From this time on reports of spontaneous fracture of metatarsal bones became more frequent. Chronologically they were recorded by Meiser,[11] Belcher,[12] Thalwitzer,[13] Tobald,[14] and Nion,[15] the latter two authors reporting the enormous numbers of 1,500 and 575 cases respectively. Tobald noted definite changes in the bone in 67.3% and no sign of fracture in 32.7%. In the 575 cases by Nion only one case of fracture of the first metatarsal was recorded, and that was of doubtful origin.

The interest in "march foot" apparently lagged during the second decade of the 20th century, the reports by Eyles,[16] 1915, and Jansen,[17] 1916, being of chief interest. Deutschlander,[18] 1921, and Runstrom,[19] 1924, again revived interest in the pathology of "marching fractures," but we find no reference to the condition in English or American literature until Jansen[17] made his classical report in 1926 before the British Orthopedic Association. Extracts from his paper are as follows:

"March foot is an edematous swelling of the metatarsal region of the foot which presents itself in persons who are made to walk beyond their strength. The pain, if present, is not severe at first. Swelling appears on the dorsum of the foot, next on the plantar surface, the latter in a less degree . . . In the beginning the swelling soon disappears with rest, sometimes in a single night, and reappears with new fatigue . . . The roentgenogram shows no changes in the bones at the onset. In the course of a few weeks however, 'even' thickenings on the metatarsal bones develop along the diaphyseal portion . . . They are never observed in those parts of the metatarsal from which no interosseous fibres (muscles) arise (first metatarsal and lateral side of the fifth). During the development of the phenomena, a metatarsal fracture may occur without a preceding trauma or even a sensation of pain so that the fracture is often a surprise both to the doctor and the patient. The first metatarsal is never fractured, the fifth only in 0.6% of the cases . . . They are more frequent in the second (54.5%), less in the third (36.8%), and least in the fourth (2.5%).

"Summarizing, we may say that march foot is due to over fatigue in a weak foot . . . causing eventual fracture."

JANSEN gives a rather new concept of the mechanism of these fractures. His theory is that in the weak over-strained fore-foot the interosseous muscles become swollen and that the swelling, by way of lymph and venous stasis, causes

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* Presented at the Twenty-Third Annual Meeting of the American Association of Industrial Physicians and Surgeons, Chicago, June, 1938.

swelling of the periosteum where these interosseous fibers arise. Thus the underlying bone is partly deprived of its nourishment and becomes more brittle. Subperiosteal hemorrhages may occur and further elevate the periosteum from the bone. At this point the x-ray picture shows the spindle-shaped enlargement along the shaft of the metatarsal though the fracture may not yet have actually occurred. Later it occurs spontaneously and, being already surrounded by callus, does not displace readily nor become any more painful. This explanation possibly accounts for the failure readily to demonstrate fractures early, and also accounts for the inability of the patient to tell when the fracture actually occurred.

Jansen's cases all occurred in soldiers who had been forced to march beyond their strength, most of them carrying heavy packs and equipment. Probably those having the weakest feet developed this pathology.

The first case of "march foot" reported in this country was that of Goldman,[20] 1928. The patient was a 29 year old man whose occupation as a peddler necessitated his carrying an 80-lb. pack every day. He developed rather insidiously an edema and swelling over the dorsum of the foot, and a fractured second metatarsal bone was found in the x-ray film.

The second case in American literature was that of Straus,[21] 1932, in a woman weighing about 170 lbs. whose change of occupation from one of sitting to one of standing behind a cafeteria counter resulted in a painful edematous swelling over the dorsum of the foot. On palpation a hard mass was felt along the course of the second metatarsal, and the x-ray picture showed a marked bony thickening, spindle-shaped, along the shaft of the bone. *No fracture was demonstrable in the x-ray film taken seven weeks after the onset of the disease!* A sarcoma was suspected and the offending metatarsal removed. Upon sectioning the bone longitudinally a transverse fracture line was found at the middle portion beneath the callus and some slight motion could be made out. Microscopically and histologically this was a fracture showing signs of early healing, so that it could not be attributed to trauma from the operative procedure.

This case demonstrates the possible existence of an undemonstrable fracture, but does not answer the question as to whether the callus followed the fracture or the fracture occurred after the formation of the callus. Jansen would hold the latter view the more logical, i.e., the increased brittleness of the bone after the increased thickening of the periosteum rendered the shaft portion more susceptible to spontaneous fracture.

Dodd,[23] in 1933, reported a case similar to that of Straus. His patient was a young woman, a golf enthusiast who spent a considerable amount of time on the links, which of course necessitated quite a bit of walking. She developed pain and a gradual swelling in the anterior metatarsal region of the right foot, but the x-ray films taken at that time showed nothing. A little more than a month later the foot was re-rayed and a spindle shaped enlargement found involving the shaft of the third metatarsal. The films were studied carefully by several competent roentgenologists, but none could make out any sign of fracture. The several opinions were unanimous that this lesion was a bone sarcoma. Consequently a lisfranc amputation was done, removing all of the forefoot including all the metatarsals. The patient's recovery was uneventful, and she was able again to play golf, wearing a specially adapted shoe. The specimen was carefully examined grossly and microscopically. No evidence of sarcoma was found, but there was a fine linear crack found in the gross specimen. Dodd thereupon concluded quite correctly that he had been dealing with a case of "march foot." There were no peculiar histologic changes found microscopically which would lead one to believe that such a case was due to endocrine disturbance or other bone dyscrasia.

APPARENTLY these are the only two cases on record in which the offending metatarsal has been available for microscopic study.

J. S. Speed and Blake,[22] in April, 1933, reported nine cases of "march foot" several of which were in nurses. They call attention to an important fact, namely, that there are in all probabilities two types of cases, both of which began in an identical manner. The first type however, subsides quickly and does not lead to fracture. The second type does not subside and eventually leads to fracture of a metatarsal. This observation may throw some light on the progress and pathology of the malady. The authors feel, and quite rightly, that recognition of the prodromal symptoms is important before the fracture has occurred. One of these cases had a double fracture, the shaft of the second and the distal end of the third. This is a quite uncommon finding.

Montieth,[24] 1934, also reports a double fracture in one foot. The first fracture (second metatarsal) could be seen easily, surrounded by a dense heavy callus, whereas there was a recent fracture of the third without visible callus in the x-ray. There was no history of injury. Blauvelt[25] reported one case in 1935, but showed no x-ray pictures in the report.

Sloan, D, and M. F.,[26] reported one case in 1935.

Elward[27] reported one good case first seen April, 1933. He followed this case, taking frequent x-ray films for nine months. He observed that callus appeared first and was quite dense in 30 days. Within 90 days the callus showed signs of absorption, and at the end of nine months had completely disappeared leaving a normal looking bone.

Maseritz,[29] January, 1936, gives a very fine historical outline of marching fracture prepared in chronological order, and brings the bibliography down to 1936. (For the bibliography of the large number of foreign contributors since 1921 I refer you to Maseritz's article.) The case which this author reports had three fractures in the metatarsals of the left foot, apparently occurring at dif-

ferent times judging from their appearance and healing. There were also noted changes in the first cunieform suggestive of fragmentation. There was also found thickening of the shaft of the third metatarsal in the opposite foot, although this did not progress to fracture. Maseritz raises the question as to whether faulty calcium metabolism may be a predetermining factor in "march foot."

Ortega,[30] Saves,[31] and Bong[32] each reported interesting cases, the details of which are similar to those already discussed. After the present paper was sent in for publication, following its presentation, in June, 1938, before the Twenty-Third Annual Meeting of Industrial Physicians and Surgeons, in Chicago, Meyerding and Pollock[33] have reported 10 cases from the Mayo Clinic and their conclusions are: "—the periosteal proliferation results from irritation at the site of fracture and is the result of imperfect mobilization." One of their cases was subjected to biopsy to confirm the diagnosis. This, then, is the third case which has been studied histologically.

THE case at hand which I wish to report was a white man, of age 59, weighing about 170 pounds, five feet seven inches tall, employed at office work. His past history was essentially negative except for an occasional mild cold and one attack of what he called "rheumatism" in his legs eight years previously, which passed off without comment within a few weeks. The urinalysis and Wassermann were negative. There were no other objective findings or evidence of focal infections. He stated that about July 1, 1937, he began wearing a pair of white shoes which did not fit well and that he noticed some discomfort across the "ball" of the left foot. He thought the shoes were too tight and found that some swelling was present over the dorsum of the foot over the area corresponding to the second metatarsal bone. This swelling disappeared overnight but reappeared the following day. During each succeeding day the swelling appeared and disappeared overnight. After a week of this the patient presented himself for medical advice. Upon strict inquiry it was brought out that he had been walking much more each day than he realized. His daily routine included a brisk walk from his home to the depot every morning. After arriving at the downtown terminal he walked across town to the office. At noon he usually walked a mile or so for exercise. At quitting time he retraced his route as in the morning and arrived home on foot for dinner. After dinner in the evening he usually went out for another walk of a mile or two, or more. When all these distances were taken into account and added up it was found that he was covering at least 10 miles a day!! This, plus an ill-fitting pair of shoes, was certainly something to consider. An x-ray film was made July 8, a little more than a week after the onset of the pain, but no changes could be made out in the foot, certainly no evidence of metatarsal fracture. He was advised to rest the foot as much as possible and to return to the use of his former shoes, discarding the pair which he considered as having caused the trouble. With rest the swelling disappeared, but on walking it again reappeared and eventually came to a point where it did not disappear. Some thickening was felt in the metatarsal region on July 22 (16 days after the first examination) but it was not pronounced.

In view of the progressive character of the ailment and the patient's insistence on walking, a walking cast was applied on July 22. This was a non-padded plaster cast with an iron stirrup embedded under the foot so that walking was possible and the body weight was distributed over the leg instead of entirely on the foot.

This arrangement afforded relief from the pain and at the same time curtailed his activities. Nevertheless the patient went to his country place in a few days, and did no little amount of work around the house, wearing the walking cast. Twelve days later the foot felt so much better that the patient removed the cast himself and got around with a cane without much discomfort. From this time on improvement was steady, but the palpable mass over the second metatarsal became quite pronounced. A second x-ray film was taken August 24, 1937, seven and one-half weeks after the onset. On this film could be seen a dense thick callus along the second left metatarsal through the center of which was a barely discernible fracture line. The patient was warned against over-use of the foot, and complied with the instructions to a certain extent. A follow-up x-ray film was obtained October 26, approximately four months after the onset of the process. The fracture line could still be made out, and the callus was still plainly visible but more dense. The visible swelling over the dorsum of the foot had disappeared, and there was no pain on lateral motion nor on flexion or extension of the foot.

A subsequent x-ray film was made February 3, eight months after the onset of the trouble. The thickened shaft of the bone could still be seen, although it appeared as solid bone and the fracture line was obliterated. Presumably somewhere between four and eight months bony healing was complete. At this time there was no complaint and the patient had resumed his habit of walking to and from work as before. At the date of writing this report, 11 months after the beginning of his disability, there has been no recurrence of the trouble.

THIS again brings to the foreground the etiology of "march foot" or marching fracture. It is felt that the case at hand was due to faulty shoes. Now, how is this correlated with previous observations? As has been pointed out, practically all authors agree that these marching fractures occur in individuals with weak feet who walk beyond their endurance. In walking the interosseous muscles come into constant action and help maintain the body equilibrium. If a shoe is improperly fitted, either too wide or too tight, a spastic condition is set up in the interossei which leads first to swelling and edema as suggested by

Fig. 1. X-ray picture taken July 7, 1937, one week after the onset of pain, shows no visible evidence of fracture in the second metatarsal bone

Fig. 2. X-ray taken August 24, 1937, seven weeks after the onset, (after patient had worn the walking cast), shows definite fracture of the shaft of the second metatarsal with well developed callus formation

Jansen.[17] The subsequent turn of events leading to early fracture has been outlined.

In the case at hand there was no question about the improperly fitting shoe. From my limited late war-time experience it is not an exaggeration to say that a great many of the recruits' shoes were not only improperly fitted but not fitted at all.

I can attest that in my company the first issue of shoes was on the grab-bag plan, and the fitting was accomplished by trading among other recruits who had smaller or larger sizes. Many ex-soldiers relate how they were fitted with shoes two sizes larger than they were accustomed to wear, if it was their good fortune to be fitted at all. The theory was that the soldiers' feet would swell, and that the swelling plus the heavier socks would require larger shoes. This was to a great extent true, but undoubtedly there were many whose shoes were far too wide to afford any reasonable support to the transverse arch. If such an individual had a rather weak foot or poor muscula-

Fig. 3. X-ray taken 16 weeks after the onset of first disability shows the dense callus which has become much more firm and bony. The fracture line is difficult to discern in the second metatarsal

Fig. 4. Final x-ray picture taken February 3, 1938, 30 weeks after the onset. The callus has become quite dense and is narrower. The fracture line is no longer seen. Patient is entirely symptom free

ture to begin with it is quite conceivable how a marching fracture might ensue.

Still the remarkable fact remains that there were no cases of march foot (pied forcé) reported among the American soldiers during the World war!

Conclusion

THERE is still left considerable room for argument as to what actually causes "march foot." Jansen's[17] view that it is associated with spasm of the interossei with resultant edema and lymph and venous stasis dysid, causing brittleness of the affected metatarsal seems to be a logical explanation in most cases. It certainly fits in with the absence of fracture in the first metatarsal which has no interosseous fibers arising from it. Abnormalties in the length of the metatarsals or faulty transverse arches have also been given careful consideration as causative factors, and yet

Fig. 5. The "Walking Cast" which was applied two weeks after the onset of pain. This is a non-padded plaster cast applied directly on the leg (without shaving the skin). The iron stirrup is applied after the first layers of the cast have hardened, to avoid denting the plaster. It is fixed in place with a few layers of plaster bandage

we constantly see people with abnormal or deformed feet who never develop "march foot."

Over fatigue has gained first place as to the initiating factor and yet we see dance marathons where the contestants are on their feet dancing continuously for months but to date there have been no reports of "march foot" in these people.

The suggestion by Speed and Blake[22] that there are cases of "march foot" which do not go on to fracture is quite true. I have seen two such cases both of which had pain, swelling and a little edema in the dorsum of the foot over the second and third metatarsal region, in neither of which could be seen any bony pathology in the roentgenogram. They were treated with rest and foot baths, and made uneventful recoveries. Had subsequent x-ray films been made it is quite likely that a typical periosteal thickening would have been made out. There must be many more cases of a like nature, and it will be possible to diagnose them accurately if they are followed with x-ray studies several weeks after the onset of the pain. One should not be content to dismiss the possibilities of "march foot" because the process subsides with rest nor because the original x-ray film shows no pathology.

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Fractures of the Humerus

—Complicated by Injury of the Musculo-Spiral Nerve: Report of Three Cases Treated Without Operation—

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FRACTURE of the humerus occurred in our series of 11,716 cases 252 times.* From these figures, you will see that fracture of the humerus, while not one of the most frequent of fractures, is quite often encountered in injuries to the bones of the body. By reason of the fact that the musculo-spiral nerve (radial nerve) winds around the humerus in the musculo-spiral groove, injury to the musculo-spiral nerve is quite frequently encountered, especially when fracture of the humerus is situated in the region of the middle third.

In the last two or three years. we have had three injuries to the musculo-spiral nerve, where the humerus has been fractured in or about the middle of the bone. In all three cases, the paralysis to the distribution of the radial nerve has been complete, and it was thought at the time of the injury, that it would most probably require nerve suture, following repair of the bone, to restore function to the nerve.

It is well recognized, that in musculo-spiral nerve paralysis or any nerve paralysis, the nerve may either be severely traumatized or may be severed in part or in toto. As a rule, where the paralysis of the muscles supplied was complete and sudden, and where the function was not partially restored in a reasonable time (10 days to two weeks) the supposition was, *formerly*, that the paralysis would be permanent and was due to complete severance of the neurones in the nerve sheath.

I desire to recount that functional nerve restoration may take place six, 10, or even 12 months following such a severe nerve injury without operative interference. Operations for nerve suturing should be withheld in these cases from eight to 12 months or even longer, if there are indications of regeneration of the nerves.

Suture of the musculo-spiral nerve is a simple procedure, and attended with a high percentage of recovery, provided the operation is done within the year. The greatest difficulty is usually encountered in locating the severed ends of the nerve; however this is not necessarily exceedingly difficult, provided you know your landmarks, and from the x-ray know where the nerve is most likely severed. Competent assistants for retraction and manipulation are very essential for a smooth operation.

I WISH to report three cases of musculo-spiral nerve paralysis due to injury from fracture of the humerus. One case was complicated by non-union. While the humerus is said to be one of the most frequent bones in the body to develop non-union, in our series of over 11,500 fractures this is the first non-union of the humerus that we have encountered.

If you will set fractures early, obtain good approximation and immobilization, and look to the nutrition of the patient, you should have very few non-union cases.

All three of these musculo-spiral nerve paralyses were treated by the *expectant plan*, and while it was thought that it might be necessary in all of them to resort to surgery—suture of the nerve—for restoration of function, almost complete function in all, save one, has resulted, without operation. In the *one* case not yet restored, sufficient time has not elapsed for restoration to have taken place (only four months since injury).

CASE No. 1, R.W.S., W.A., aged 41, was injured by being struck with the dipper of a steam shovel.

The patient walked into the Sanitarium with great deformity in the middle third of the right upper arm, with swelling, discoloration and crepitation. There was a small puncture wound on the under side of the arm, compounding the fracture. The x-rays showed a comminuted fracture of the right humerus in the middle third, with much angulation and displacement. There was the typical impairment of the sensation and function over the course of the radial nerve.

This is an important notation, for rough handling, either during the administration of the first aid or in the setting of the fractures, may injure the nerve and cause the paralysis.

Callus formation two or three weeks later may produce a temporary paralysis of the nerve.

Under novocaine anesthesia, the fracture was reduced and put up in *our* areoplane splint. Patient remained in the Sanitarium for 10 days. General anesthesia is usually preferable in these cases, but this patient objected to a general anesthetic.

This fracture united satisfactorily in four months, but the function of the nerve was not restored by that time.

Six months after the injury, the patient showed no improvement, in the drop wrist, in supination, and in ability to extend his fingers. Operation was

* Presented at the Forty-First Annual Meeting of the Association of Surgeons of the Southern Railway System, New Orleans, May 24-26, 1938.

considered at this time for nerve suture. However, eight months after the accident, the patient showed improvement in nerve function, and 10 months after the accident he had only slight impairment of function in the index finger and thumb. In a little more than a year following the accident, he had splendid restoration of function with little or no muscle atrophy.

Fig. 1. (Case 2) x-ray—J. S.—showing fracture junction middle and lower third humerus injuring the musculo-spiral nerve

This case is especially interesting as no improvement in nerve function had developed during the first six months, and when improvement did begin, it was rapid and definite and almost complete in two or three months.

CASE No. 2 J.S., W.A., aged 46, injured in 1936.

This patient was brought to the Sanitarium in shock following injury in a railroad crossing accident. His pulse was barely perceptible. He had a deep laceration over the left temple region, also on the back of the left leg and over the lumbar spine; great deformity in the right arm and forearm.

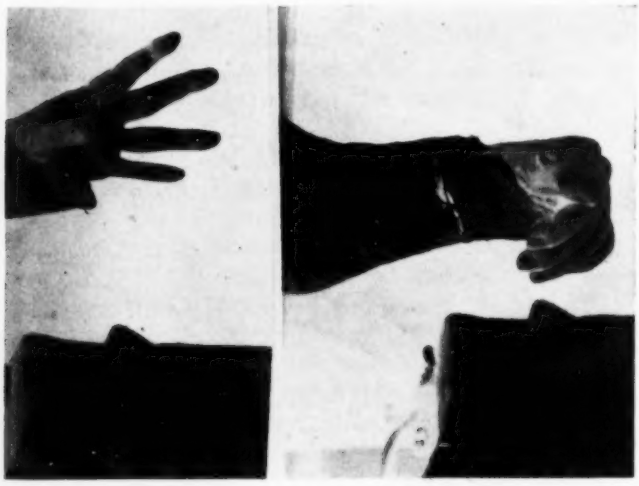

Fig. 2. (Case 2)—J. S.—showing function hand—flexion—extension—following eight months paralysis

X-rays showed fracture into base of skull and also fracture of the right humerus and ulna. The patient had paralysis of the muscles supplied by musculo-spiral nerve of right arm, wrist, and hand.

A temporary splint was applied to the right arm and forearm. The patient was treated for grave brain trauma. Treatment for other injuries was made subservient to treatment of shock and brain trauma. The recovery was tedious. Non-union of humerus resulted. The areoplane splint was applied when the condition of the patient justified it. Later the upper arm was placed in a plaster cast for a number of months to see if the musculo-spiral paralysis and non-union would improve. Under immobilization and supervised nutrition, the paralysis entirely cleared up in 10 to 12 months. The patient has nearly perfect nerve function now, but had to have an open operation with suture of freshened ends of bones, using copper wire and 40-day chromic catgut for the non-union.

CASE No. 3, L.W.M., W.A., aged 41, injured January 13, 1938.

This patient, a railroader, was brought to the Sanitarium in an ambulance, conscious, but did not remember how he sustained his injury. He had fallen from a "cut of cars," and was injured on opposite track. He had severe concussion of the brain. X-ray films revealed a fracture of the right humerus in the middle third, with marked angulation. He also had fracture of the ulna in the middle third with frank overriding. There was a dislocation of the head of the right radius. He suffered a three-inch laceration over the frontal bone; the upper lip was completely severed to ala right side of nose, and his two upper central incisors were broken off; multiple abrasions and lacerations were present. There was definite right radial nerve injury; drop wrist; and loss of supination and of extension of all fingers.

Fig. 3. (Case 3)—L.W M.—showing home-made areoplane splint—cockup posture—hand and wrist

Under general anesthesia, the dislocation of the head of the radius was reduced, the fracture of the humerus approximated, an areoplane splint applied and the wounds sutured. Although there was an oblique fracture near the middle of the ulna with overriding, and deformity, no setting was attempted until the patient came out of shock and his general condition warranted it. On the eleventh day, following the accident, under local

anesthesia, open operation with almost perfect approximation was done, with no discomfort to the patient. No sutures in the bone were used, as the jagged fractures held the ulna in good approximation and correct alignment. Previous x-rays show elbow perfect.

Later x-rays show a good amount of callus in both the humerus and ulna fractures, but there is little or no restoration of radial nerve function at this time. It is too early for it to have developed, yet I hope for and expect as perfect a result as occurred in the two previously reported cases.

On May 23, 1938, this patient has complete sensation in the posterior surface of forearm, back of hand, and fingers, and has extension above 50% of thumb. This has taken place in the last 10 days. It is now four months and 10 days since the accident.

Conclusions

MUSCULO-SPIRAL palsy is common in gross fractures, in and about the middle third of humerus.

2. One should avoid rough handling in the treatment of all fractures, but especially in fractures of the humerus to avoid further nerve injury and paralysis. Fifty-eight per cent of all nerve injuries due to fractures occur to the musculo-spiral nerve.

3. Ordinarily one should wait in musculo-spiral paralysis from six to 10 months for signs of nerve regeneration before operating. This refers to closed cases. Faradic and galvanic tests for nerve function are sometimes helpful but not always so.

4. Should there be no signs of recovery of function by the above time, do nerve suture, preferably under local anesthesia, assisted by some of the barbiturates and a preliminary hypodermic of morphine and atropine.

5. While waiting for nerve regeneration, passive motion, massage and some of the forms of physiotherapy should be used. Patience, along with the intelligent supervision of the case, will accomplish a great deal in reducing the number of operations for nerve repair; will reduce morbidity; will shorten the number of sick days; and will greatly reduce the expense to the railroads, corporations, industries, or to the patient.

Treatment of Chronic Leg Ulcers

—Due to Varicosities—

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VARICOSE ulcers, like so many other conditions to which the human body is heir, are preventable if the primary disease or abnormality is treated early.* Ignorance, indifference and poverty on the part of the patient suffering from varicose veins eventually are directly responsible for the ulceration which may be considered a complication of the former condition.

This brings us to a discussion of the etiology of varicose ulcers.

It is well known that untreated or improperly treated varicose veins produce certain cutaneous and subcutaneous changes. This is the prime factor in the development of ulceration which so often takes place in the lower extremity in which a varicose state exists. Anything such as trauma or skin infections may produce an ulcer in this area of skin where normal physiology and metabolism have been impaired by the stagnation of blood in the dilated veins. According to Oschner, varicose ulcers develop as a result of venous stasis which leads to anoxemia and stagnation of metabolic processes in this region. The changes thus produced provide ideal conditions for the development of infection. Here even the slightest trauma may cause a break in the epithelium allowing bacterial invasion of the skin and subcutaneous tissues, the normal resistance of which has been impaired by the changes mentioned above. Such a lesion is found most often in the lower third of the leg frequently over the tibia and internal malleolus.

Next, let us consider briefly the pathological picture of a varicose ulcer. The size and appearance vary, depending largely upon the duration. The surrounding skin is rather brawny and has a brownish pigmentation. The edges of the ulcer are somewhat irregular and slope toward the crater which is covered with dusky granulations and bathed in a turbid exudate. There may be a diffuse fibrosis surrounding the lesion and beneath its base. This naturally interferes with the arterial supply and lymph drainage. In several places around the ulcer there may be seen or felt venous lakes formed by the varicosities. The whole picture is one suggestive of chronicity.

The diagnosis of the lesion is usually evident when one finds such a condition as described above. Routine serological tests should be done to rule out syphilis, and if these are positive specific therapy is begun.

So often the proper management of a pathological condition is complicated by an economic problem. The majority of patients in whom varicose ulcers are seen, live a "hand-to-mouth" existence and cannot afford to remain in bed for a long period of time. It is well known that most varicose ulcers, certainly the less chronic ones, will heal following prolonged rest in bed with elevation of the extremity, but in most cases this is not practical, and good results can be obtained with a minimum of time loss to the patient.

Understanding, then, the pathology, treatment is directed toward combatting the underlying cause as well as to the lesion itself. If any active infection is present in the ulcer a few days' rest in bed with local application of Oschner's or hypertonic salt solution will usually control this. Then, in the smaller ulcers, good results may be expected

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in most cases from adhesive strapping. This method is preferred because it is easily carried out, is economical, the patient remains ambulatory, and it gives firm and adequate support to the dilated veins. It is thought to be desirable if possible to bring about healing in the ulcer before actively sclerosing the varicosities. Some prefer to begin active obliteration of the varicose veins as soon as treatment of the ulcer is started, but we have obtained better results by waiting until the ulcer is at least partially healed before correcting the varicosities by injections.

The technique of strapping is simple. The ulcer is first thoroughly cleaned with ether and alcohol and dried. The lesion is then painted with a 10% solution of silver nitrate. After shaving the leg to the knee if necessary, beginning in the metatarsal region, using two- or three-inch adhesive, successive overlapping strips are applied up to the knee.

The adhesive is applied so that it is in direct contact with the ulcer, and thus the foot and leg are encased in an adhesive stocking except the toes and heel. Some prefer elastic adhesive, but the "plain" has proved very satisfactory in the Outpatient Department of the John Gaston Hospital where a large number of cases have been treated in this manner. The adhesive is applied firmly enough to at least partially if not completely occlude the large superficial dilated veins. Thus the varicosities are temporarily corrected and the venous drainage is through the deep vessels. The ulcer is bathed in its own secretion, and this apparently is a stimulus to healing. The patient is told to return immediately if severe pain is experienced, since this would indicate an inadequate deep circulation which is of course a contra-indication for this method of treatment. If no severe discomfort is caused, the adhesive is not removed for five to seven days, when it is reapplied in the same manner. After removing the first strapping usually epithelium can be seen growing in, reducing the size of the defect. From four to 10 applications are necessary to bring about healing. This naturally is a variable factor depending upon the size and duration of the ulcer, the arterial blood supply and the individual response to this type of treatment.

If a patient's skin is found to be sensitive to the adhesive this method must be discontinued, and an elastic bandage is used, applying it tightly enough to compress the dilated veins.

AFTER healing of the ulcer has been accomplished there is still the problem of the varicose veins to be solved, for unless this is done there will be a recurrence of the ulcer. The literature of recent years contains many articles concerning the treatment of varicosities of the lower extremities, most of which deal with the injection method. In advanced cases preliminary ligation of the internal saphenous vein is advocated; when an ulcer of the varicose type develops, the veins of that extremity are as a rule in a rather advanced state of varicosity. Therefore this treatment should be carried out without delay after the ulcer is healed or has begun to heal. The patency of the deep circulation has already been established if the patient allows the first adhesive strapping to remain in place. Otherwise, severe pain would be experienced on walking shortly after the adhesive is applied. An incompetent deep circulation is the one positive contra-indication to obliteration of the superficial veins. Other conditions in which ligation and injection should be employed with caution, if at all, are advanced cardiovascular and cariorenal disease, diabetes, peripheral arterial disease and recent thrombophlebitis.

The Trendelenberg test, with which you are familiar, is of value in determining the competence or incompetence of the valves. A negative test indicates that only the superficial valves are incompetent, while a positive result means that there is also regurgitation of blood into the saphenous from the femoral vein. This finding is usually present where an ulcer has developed, and is a definite indication for ligation before injection. A double positive result indicates that there is also an incompetence of the valves of the intercommunicating veins between the superficial and deep circulation. This frequently necessitates multiple ligations and excision combined with injection. Mahorner and Oschner have described a test by which it is possible to determine at what level of the leg there is regurgitation of blood from the deep circulation of the superficial through the communicating veins. The patient with legs bare walks to and fro in front of the observer and the size of the varicosities is noted. A tourniquet is then placed around the upper third of the thigh so as to obstruct the superficial veins and walking is continued. Successively the tourniquet is lowered to the middle third and to the lower third of the thigh, each time noting carefully the amount of dilatation of the veins. If the veins are more dilated when the constriction is placed in the upper third than when it is lowered, it must be concluded that there is regurgitation of blood through a communicating branch from the femoral to the saphenous. In this instance high ligation alone would not cure the varicosities, and additional ligations must be done lower. With this test it is possible to better localize the point of regurgitation from the deep to the superficial veins. If one uses this test carefully there should be fewer recurrences even in the face of a double positive Trendelenberg test which, as previously stated, indicates incompetence of the valves of the communicating veins.

In the usual case ligation at the saphenophemoral junction followed by multiple injections is the treatment of choice. The patency of deep circulation has of course previously been determined by temporary mechanical occlusion of the superficial veins by adhesive strapping or an elastic bandage. The technique of the operation will be given briefly.

The procedure may be undertaken in the office

if the necessary sterile equipment is available, but it is more satisfactory to have the patient hospitalized for 12 to 24 hours. Local anesthesia of 1% novocaine is used. The femoral artery is palpated just below Poupart's ligament and the incision is made just medial to the artery and about one-half inch below the ligament. A one and one-half to two-inch incision is ample, and the vein is located just beneath the superficial fascia. A clean dissection of the vein is made up to its junction with the femoral and the smaller tributaries entering the saphenous in this region are ligated and cut. The main trunk of the saphenous vein is ligated about 1 cm. from the femoral. Here, following the method used at the Lahey Clinic, retrograde injection of 10 to 20 cc. of a solution of 10% saline and 30% glucose is made distal to the ligature. This usually obliterates the veins down to the knee. The vein is again ligated below the point of injection and the intervening section of vein is removed. If it is necessary to ligate the saphenous in the lower third of the thigh also, because of incompetent valves in the communicating veins, the procedure is carried out at this time. The patient may leave the hospital immediately, but a few hours' observation is considered preferable.

Injections to the veins below the knee are begun when the patient returns for removal of skin sutures and are continued at five- to seven-day intervals until all palpable varicosities are sclerosed.

The solution employed for these injections is 5% sodium morrhuate and at each treatment two or three areas are injected, allowing about 2 cc. for each area. If the injections are begun before the ulcer is entirely healed, the adhesive strapping is replaced after each injection treatment. If healing of the ulcer has been accomplished the patient is instructed to wear an Ace elastic bandage or an elastic stocking constantly, taking it off only to bathe or on retiring at night. It is advisable to continue wearing some elastic support for at least two months after the injections are completed.

Regarding recurrences, the work of Howard in 1934 shows that in his series of cases there was recanalization of veins in 100% of the patients treated by ligation and injection. The percentage of recurrence of the varicosities, however, was only 23%, and in only 15% was there a return of symptoms. At the present time combined ligation and injection seems to be the treatment of choice in dealing with varicose veins.

In treating some of the larger ulcers Unna's paste boot is advocated by some. This method seems more applicable in those cases where there is a great deal of edema and induration present in the affected leg.

When a large ulcer has been present for several years and there is dense scarring surrounding the lesion and beneath its base, the treatment becomes more complicated. There is impairment of the arterial blood supply and lymph drainage as well as a stagnation of venous blood caused by the varicosities. Here the patient must be hospitalized and the ulcer together with the surrounding scar tissue is removed and the wound allowed to granulate. After suitable granulations have formed, skin grafting is done to close the defect. Here, too, the underlying cause, the varicose veins must be obliterated in order to avoid a recurrence of the ulcer.

Another method of treating chronic varicose ulcers is by means of acetyl-beta-methylcholine-chloride iontophoresis. Kovacs, Saylor, Duryee, and Wright report 26 cases of chronic ulcers which had been present from one to 37 years, and in only three patients were the results unsatisfactory. Reinforced asbestos paper is saturated with the drug and wrapped around the foot and leg as high as the knee. A metal plate is placed over the asbestos paper and connected to the positive pole of a galvanic machine. The despersive electrode is placed under the back of the patient and connected to the negative pole. The current is turned on and increased to 20 or 30 milliamperes. A local blush of the skin is produced with elevated temperature and marked sweating which may continue from six to eight hours. We have not used this method of treatment, but apparently good results have been obtained.

Summary and Conclusions

VARICOSE ulcers are a direct result of varicose veins, and early treatment of the latter condition will prevent ulceration.

2. Adhesive strapping of the foot and leg up to the knee will bring about healing in practically all of the smaller ulcers. This is followed or accompanied by active obliteration of the dilated veins.

3. Extremely large ulcers surrounded by much fibrosis frequently must be exercised and skin grafting done at a later date.

4. The technique of ligation and injection is reviewed, stressing the importance of multiple ligations where there is incompetence of the valves of the communicating veins.

5. Unna's paste boot is of value in some of the more chronic ulcers accompanied by edema of the leg. Iontophoresis with acetyl-beta-methylcholine chloride is briefly described.

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New Books

Industrial Surgery

— Review by —

FREDERICK W. SLOBE, M.D., F.A.C.S.

INDUSTRIAL SURGERY, by Willis W. Lasher, M.D., F.A.C.S. Published by Paul B. Hoeber, Inc., New York. The author's extensive experience in the practice and teaching of industrial medicine and survery have rendered him eminently qualified to write this book. The work contains 542 pages, 193 illustrations, and a bibliography of 220 references. The cost is $6.00.

The first chapter dealing with the organization of the medical department is a valuable one, covering pre-employment examinations, medical personnel, consultants, duties of the medical director, and it includes charts showing both the detailed equipment and arrangement of treatment rooms.

Following this the author progresses directly into the clinical aspect of practice, discussing first the various affections of joints. It is interesting to note that in the 26 pages devoted to this subject the author finds space to discuss the embryology, histology, and bio-chemistry of joints.

It is stated that in 20,000 industrial accidents, over 25% involved fingers. Rather than the prolonged immobilization so often required in treating fractures of the carpal scaphoid bone, the author prefers the removal of either the entire bone or its proximal half; since, with either method, the ultimate disability is approximately the same, the time saved by the latter procedure renders it preferable. He also advocates excision of dislocated semilunar bones for the reason that he has been unable to effect a closed reduction. This statement is at great variance with the experience of many surgeons who not infrequently have been able to reduce this bone by manipulation. Oddly too, though consistent with time-worn orthodox medical teaching, the author discusses the treatment of ganglion by rupturing it, whereas digital pressure will usually accomplish this without danger of fracturing the carpal bones. The disabling radio-carpal separations are said to be best operated upon and in forearm fractures the supination position is favored.

The chapter on knee injuries is excellent. The symptoms, diagnosis, and treatment of semilunar cartilage injuries are covered in a clear, complete, and practical manner that leaves little to be desired.

Lasher has never found an instance of sacro-iliac separation in the absence of a fracture. He does not believe that an injury can be considered as either aggravating a pre-existing infection or as a causal agent in localizing an infection in the sacro-iliac or any other joint unless immediate and continued pain follows a rather severe trauma. In 200 back injuries studied the majority were under 40 years of age and the condition was most prevalent in short, heavy set, or obese individuals. Disability in young men and old men was about the same. The significant statement is made that, "If a careful history and physical examination (including Goldthwaits', Lasegue's, Patrick's ad other tests) are made, together with therapeutic tests and repeated x-rays, more than 90% of industrial back conditions can be satisfactorily disposed of." Some very helpful hints for procedures to follow in the routine examination of back strains are given.

The section on malingering is subdivided into three groups: (1) the outright wilful deceivers; (2) unintentional malingerers, that is, those with "honest convictions;" (3) combinations of 1 and 2. The outright malingerers, again, are subdivided into three groups: (a) those without any pathological basis; (b) those exaggerating their symptoms; (c) those attempting to hide old diseases or previous injuries. The technic of handling and examining these patients is described. Those with experience in this field will quite agree with Lasher's statements that he is suspicious of the individual who uses the expression that he "wants only to be cured;" also that one should never tell the unwilful malingerer that nothing is wrong.

Cranio-cerebral injuries and the hernia problem are discussed with as much detail as one would expect to find in a book of this size. A brief discussion is devoted to such subjects as plumbism, carbon-monoxide poisoning, electric shock, caisson disease, and pneumoconiosis. The same applies to the discussion of trauma to the thoracic and abdominal viscera.

An appendix of 23 pages discusses plaster-of-Paris bandages, splints, and various types of apparatus and gadgets found useful by the author.

The book abounds with personal impressions gained by the author after an extended experience with traumatic surgery. He expresses his opinion freely and frankly. It is to be expected that certain of his experiences and conclusions will not correspond with the experience of others. Since there are several means to an end, physicians, usually being individualists, are likely to become addicted to one procedure or trend of thought. Dr. Lasher, however, by quoting from the extensive bibliography listed by him has not only given us countless practical pointers based on his own view point but also analyzes the literature pertinent to the subjects. In many ways this book is unique in its appeal to those interested in the surgery of trauma and in industrial medicine. Experience remains the greatest teacher and, since the transmission by personal contact of the knowledge thus gained is so limited, the profession is indebted to Dr. Lasher for disseminating this valuable information in book form.

Industrial Hygiene

— Review by —

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INDUSTRIAL HYGIENE, by Willard Machle, M.D., and Lawrence B. Chenoweth, M.D. Published in October, 1938, by F. S. Crofts & Co., 41 Union Square West, New York City; 235 pages; price $2.00.

This work is essentially a handbook of hygiene and toxicology for engineers and plant managers, intended primarily as a textbook for engineering students and other persons who are studying industrial hygiene.

A foreword to the volume was written by Herman Schneider, Dean of the College of Engineering and Commerce, University of Cincinnati, particularly emphasizing that industrial hygiene has become not only an item of good business in industry, but a major consideration in a wholesome program of humane responsibility.

The chapter headings give a fairly good idea of the contents of the book—such subjects being considered as workmen's compensation; industrial accidents; fatigue; physical factors in industrial hygiene; health service in industry; first aid treatment of injuries; occupational intoxication; chemical burns: oxygen deficiency and asphyxia; dust diseases; respirators, gas masks, and breathing apparatus; occupational affections of the skin; industrial neuroses and malingering; and miscellaneous occupational affections. The appendix contains material on the subjects of bandaging; additional information on splinting; methods of rescue in asphyxiation; artificial respiration other than the Schaefer prone pressure method; and transportation of the injured.

The book is obviously not a textbook on occupational diseases and does not make any claim to being such. Because the responsibility for the control of industrial hazards has come to be placed on nonmedical persons very largely (according to the conceptions of the authors) the material should have an especial appeal to nonmedical persons who have found it necessary to become informed in this field of endeavor. There are, however, a considerable number of medical men whose daily work does not bring them into active contact with industrial hygiene problems, but who occasionally find it necessary to deal with the principles involved in such problems—the material in this book should be of value to physicians who are doing this type of work. The volume contains numerous illustrations and tabulations used to good effect.

Industrial Medicine

Reg. U. S. Pat. Off.

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State Surveys of Industrial Hygiene

IN 1902, C. F. L. Doering made the first official survey of industrial hygiene in America. This was done under the Honorable Carroll D. Wright, U. S. Labor Commissioner, and the survey was made at the government shops in the District of Columbia. In 1905, Massachusetts investigated various lines of manufacturing under Dr. William C. Hanson, and in 1908 Dr. C. T. Graham-Rogers began publication of his valuable reports while inspector of factories in New York State. There followed the survey in 1910 by the Illinois Commission on Occupational Diseases under the direction of Dr. Alice Hamilton. Following these came the extensive inquiry, chiefly legal hearings with some special reports, by the New York State Factory Investigation Commission under Dr. George M. Price, 1912-1914, and the survey of industrial health hazards and occupational diseases in Ohio under Dr. Emery R. Hayhurst, 1913-1915. The latter covered 1,040 establishments and about one-half of those industrially employed, omitting coal mines. Also, all actual and potential health hazards were listed by occupations as found by physicians and hygienists, and an extensive report was published.

The occurrence of the World War deterred other notable statewide surveys practically to the present time, but during this period industrial establishments, safety organizations, insurance companies and some official departments made and reported many local surveys.

These older surveys generally sampled by precognition of "good," "fair," and "bad" places or operations, and by selecting some large, some medium, and, usually proportionately more, smaller places of employment. At times only given occupations or occupational-designations were surveyed, for example, "100 brass foundries," or several hundred painters, etc. The modern development of these surveys may be seen from the following examples.

IN 1934, the Office of Industrial Hygiene and Sanitation of the U. S. Public Health Service devised a general plan to be followed for state surveys,[1] by which the potentialities of exposure to industrial health hazards could be judged by means of a preliminary survey made of about 630 plants in a typical industrial area. The work was done within three months' time with the assistance of some 40 engineers provided through the agency of the Civil Works Act. This study, because of the limitation of time, personnel, and funds, included only "manufacturing and mechanical industries" from the U. S. Census classification of some eight groups under gainful occupations. Two standard forms were devised, the first pertaining to the Manufacturing Plant (*general information* — identification of plant, number of work rooms, kind of products manufactured, number and types of buildings; *remarks; industrial welfare provisions*—safety and medical; and *disability statistics*—sick benefit association, records of disability and time loss from sickness and accidents). The second form covered the Work Room Survey (*general*—identification, work performed in room; *general sanitary provisions*—lunch room, cloak room, washing, toilet and drinking facilities; *accident exposure; fumes and gases; other poisons; dusty processes;* and *job analysis* — the latter by code number, name of occupation, number of males and females, nature of job, raw materials, and end products).

A "PRACTICAL Application of an Industrial Health Appraisal Form" was reported upon by Bristol[2] in 1936, in relation to the American Telephone and Telegraph Company. Company "A" covered its employments, involving 4,453 persons, in one of the small states; Company "B", with 16,789 employees, in one of the larger states; and Company "C" with 21,536 employees, in a territory covering several states. The chief feature was, trial scoring against original and assigned values totaling 1,000. These encompassed vital

1. P. H. Bull. 216, Potential Problems of Industrial Hygiene in a Typical Industrial Area in the United States, by J. J. BLOOMFIELD, W. SCOTT JOHNSON, and R. R. SAYERS, 35 pages, 1934.
2. BRISTOL, LEVERETT D.: *Am. J. Pub. Health*, 26,4:390-395 (April) 1936.

statistics activities (75), communicable disease control (150), tuberculosis control (100), occupational disease and accident control (200), personal and environmental hygiene in the workplace (400), and general health publicity (75). These activities were broken down under various subdivisions, with allotted scores.

UNDER the sub-title, "How to Make the Industrial Hygiene Survey," Dr. Carey P. McCord[3] enumerated seven steps, also remarking that in "a good type of survey . . . . in the average medium-sized plant, employing some such number as 500 workers, it is often necessary to devote as much as one month in the procurement of essential information."

Another method of making industrial hygiene surveys is that of waiting until occupational disease reports or complaints are made, following which the given place is investigated, and the investigation extended to other places of employment in the same or closely related industries. Such surveys, as might be expected, usually develop more instances of actual hazards.

We have the record also of the careful observations of an epidemiologist who secretly observed the opportunity for transference of infection on the part of an executive whose duties required frequent conferences, in which nearly one hundred "slips" were detected in the space of two hours whereby infection might be transferred from one to another, but all considered subject to prevention if proper precautions were taken.

BEGINNING with "The Evaluation of the Industrial Hygiene Problems of a State," worked out by J. J. Bloomfield, sanitary engineer, and Mary F. Peyton, chemist of the U. S. Public Health Service in application to the State of Maryland,[4] a series of similar investigations are now in process or have been completed in the States of Virginia, South Carolina, Utah, Idaho, Maine, New Hampshire, Ohio, Indiana, Illinois, Iowa, Tennessee, and Arkansas. The first four of these have been completed and their reports, varying from 35 to 125 pages, are now available in printed form. As of May 1, 1938, 23 state departments of health and two state departments of labor are carrying on cooperative programs in industrial hygiene. Four city governments are doing similar work, and several other states are about to undertake such activities.

As planned, only potential health hazards, chiefly chemicals and dusts, are covered in a comprehensive and intensive manner, although inquiry is made of the extent of general sanitary conditions, safety and medical provisions, and the availability of disability statistics. It has not been the purpose to cover occupational diseases, and other related medical features.

While the plan of survey varies somewhat in different states, that in Maryland, undertaken at the request of the Maryland Commission for the Study of Occupational Diseases, comprised a sampling procedure for business engaged in the manufacturing and mechanical industries, for the reason that the majority of occupations in that state in other Census groupings, were considered not to expose to specific occupational disease hazards. In Maryland, out of 672,906 gainful workers, according to the 1930 Census report, 534,699 were classified by industrial or service group, from which a representative sample of 136,422 was selected for survey. For these, 1,179 establishments were analyzed and occupational exposure to specific materials determined.

The Maryland study was conducted by 35 persons from the State and Baltimore City Department of Health and the State Commission of Labor and Statistics. The basic data were collected on two standard survey forms, devised to yield the required information without depending too much upon the judgment of the surveyor. The allotted time for the field work was seven weeks. The editing of findings was conducted simultaneously with the field studies, while an office force coded and tabulated the information as soon as received. Thus it was possible to analyze the data immediately at the completion of the field survey. Prior to the conduct of the study, the various individuals who were to take part in it were given a series of lectures on industrial hygiene and instructed in the technique to be used.

VIRGINIA has reported the most elaborate, and in some respects, the most detailed survey to date. Several of the tables require infolds. There is likewise a very instructive state map showing, by counties, the total number of industries with five or more employees as compared with the number of industries covered in the preliminary survey. Of 880,276 workers listed in the 1930 Census, 87,040, or approximately 10%, were included in the survey, which was made of 746 selected plants. Expanding the data obtained so as to include the entire population of the industries surveyed, the greatest number were estimated to be exposed to organic dusts (57,200), but it was found that over 16,000 might be exposed to silica dusts and nearly 41,000 to silicate dusts, while the estimated number exposed to various gases totaled 53,400, with carbon monoxide leading. Lead and its compounds could be expected to affect 13,600, dermatitis-producing materials 54,900, organic solvents 20,000, etc. Only about 4% of the plants employed over 500 workers, which engaged about 40% of the workers employed. Approximately one-quarter million workers were estimated to be employed in types of industry where occupational diseases may or have been known to exist of which number about 150,000 were in plants employing lses than 500 persons.

FROM the industrial directory in South Carolina, approximately 400 plants and establishments were selected as presenting potential occupational hazards. Of these, 205 were covered by the survey, of which 51 were textile. However, the

3. McCord, Carey P.: Detecting Industry's Harmful Exposures. *Industrial Medicine*, 6,5:288-291 (May) 1937.
4. U. S. Public Health Service: Public Health Bulletin 236, 126 pages, 1937.

survey reports on 209 establishments employing 38,188 workers of whom 25,099 were in the textile industry. Some 83.3% of the employees covered were in plants having more than 100 employees, but it was found that the larger plants by no means provided better facilities for their workers, in contrast to the general rule prevailing in other states. No plant in the state employed a full-time safety director or a full-time physician, while only 24.2% had the benefits of the services of a part-time physician. Provisions for accident prevention, however, were outstanding, largely because of the law and relations to compensation already existing. Among the 38,188 workers, there were found 49,307 exposures to the principal toxic materials and conditions in their industrial environment — some workers being exposed to two or more hazards.

In Utah, mines were also covered. Here the 12 surveyors could be spared for the work only part-time, since all were required to perform a minimum amount of their regular state duties. Of some 360 establishments selected for study, 297 were analyzed. The Census for 1930 showed an industrial population of 77,145, of whom 29,068 were in manufacturing and mechanical industries, 12,521 in the extraction of minerals with 22,516 in transportation and communication and 13,040 in domestic and personal service. In summary, of 25,122 workers surveyed, 21,902, or 87%, were potentially exposed to one or more of specified hazardous materials of whom only 43.9% had any specified control methods available. Nearly 78% were employed in larger plants where 47% had some type of protection, but less than one-third of those in smaller plants were so provided.

THE present state surveys may be called qualitative and concern chiefly inquiries about substances contacted, used or formed in manufacture. The applications of precision methods are not yet in order. Much latitude is taken in regard to what may be considered potentially hazardous substances with no implication that the relatively large number of workers manipulating or exposed to substances are actually exposed to any hazard.

In some respects these surveys may be said to resemble traffic hazard surveys limited to industrial centers and sampled only at intervaled locations, based on fore-knowledge from various origins. Obviously their value depends upon the sampling method used, and the skill of the samplers and informers, so that results are simply indicative or suggestive and not necessarily related at all closely to the accidents which occur.

The meat of the present surveys is the list of hazardous materials and to some extent atmospheric conditions in various industries and occupations. The numbers of employees in the various samplings, as compared with Census figures, are then projected so that the expected number of persons exposed can be estimated for the entire group in the given state.

The total numbers exposed to potential hazards reach large figures. The most notable shortcoming thus far found has been the absence of medical supervision while on the job.

It seems logical to presume that these surveys will be followed by a keener search for occupational diseases and promotion of educational hygiene as well as closer scrutiny of sickness disability among workers. The latter is already known to be very high in certain trades and callings, and especially among the unskilled and semi-skilled.

A marked increase in the use of protective equipment and methods is a natural consequence to be expected, as well as the extension of physical examinations, and the broadening of health control measures. The six to eight hours per day of that period of 24 hours when a person is employed is thus brought definitely into the picture. Its practical absence of recognition in nearly all the state health department programs has been a hiatus far too long.

AS FAR as can be learned the whole "potential hazards" survey movement appears to have the endorsement of employment and labor, since it develops certain facts and offers correlation of knowledge with knowledge by which problems eventually reach their solution. There also results a distinct educational feature and proving ground for securing permanent personnel, to which should be added the definite educational experience for many employers who often learn, for the first time, that various substances which they elaborate are considered potentially hazardous to health.

While the financial outlays for the present surveys are relatively high, since practically all departments concerned have had their budgets boosted many times over, if indeed they had any prior budgets for the purpose, the funds have been chiefly derived from subsidies allotted to the various state health departments under the Social Security Act for extension of industrial hygiene programs.

The contained conclusions and recommendations of these surveys are calculated to mitigate or abolish the hazards present. Where they have not been made by those trained in physiology, pathology, medicine, and hygiene, they, of course, evaluate these features only indirectly. Being limited also practically to hazardous substances they do not, as a rule, relate to such hazards as illumination, fatigue, infection, overcrowding, and fitness of workers for jobs. However, they inquire into provisions for medical examinations so that the latter feature is indirectly stressed. In time, these surveys will no doubt be followed to greater completeness, and thus fulfill the title of "The industrial hygiene problems of the State." The task is tremendous and, beginning with the securing of knowledge of potentially dangerous substances and the nature of welfare and general sanitary provisions, is a logical first step.

Obviously the control rests in the hands of the physician and engineer with the integrated cooperation of nurses, laboratory workers, statisticians, administrators, and others.

INDUSTRIAL HEALTH AND DISEASE

What Every Health Officer Should Know

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IF I understand the mind of the health officer, he is interested primarily in organization, administration, and legislation, rather than in details pertaining to industrial toxicology or various industrial health hazards.* Our Section has Committees on Lead Poisoning, Compensation, Volatile Solvents, Skin Irritants, Ventilation, and other allied subjects. The reports of these committees are printed in the Association *Year Book*, reference to which many be made for recent developments along these lines.

Organization and Administration

POSSIBLY the most important development during the last year has been the creation of a Council on Industrial Health by the American Medical Association. This council is now in the process of being organized, and will function as a standing committee of the Board of Trustees of the American Medical Association.

During recent years, in addition to the work which various private industrial organizations have carried on, three federal agencies have been active in this field. The Division of Industrial Hygiene of the U. S. Public Health Service has exerted a stimulating leadership in this field and has carried on scientific studies and promotional work with reference to various industrial health hazards. The Bureau of Mines in the Department of the Interior has carried on studies particularly among the mineral and allied industries, while the U. S. Department of Labor has been instrumental in securing uniform laws, and has carried on important statistical studies.

During the past year or two a marked advance has taken place in the organization of state and local bureaus of industrial hygiene. This advance undoubtedly has been due to the leadership of the Division of Industrial Hygiene of the U. S. Public Health Service, as well as the Committee on Industrial Hygiene of the Conference of State and Provincial Health Authorities of North America.

According to information supplied by the U. S. Public Health Service, the following 22 states at present have divisions of industrial hygiene in their state departments of health: Alabama, California, Connecticut, Illinois, Indiana, Iowa, Kansas, Michigan, Mississippi, Missouri, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia and Wisconsin. In two states (New York and Massachusetts) such bureaus are established in the state departments of labor.

In addition to the development of such divisions in state departments of health and labor, four cities have inaugurated such divisions of industrial hygiene in their city departments of health, namely, Baltimore, Detroit, St. Louis, and San Francisco.

Demand for Trained Personnel

ONE result of the marked advance in the development of Bureaus of Industrial Hygiene in state and local units has been an increased demand for trained personnel which it has been difficult to meet. This emphasizes the need for a more comprehensive program of teaching industrial hygiene in medical and public health schools throughout the country. In a survey which I made two or three years ago, it was found that only 13 out of 85 medical and public health schools in the United States and Canada give separate courses on industrial hygiene or industrial medicine. Several medical schools include one or two lectures on this subject in their general course on preventive medicine and public health, while a considerable number of such schools give no attention whatever to this important and growing subject.

Occupational Disease Compensation

THE following 13 states now have compensation legislation covering a limited list of specific occupational diseases: Kentucky, Minnesota, Nebraska, New Jersey, North Carolina, Ohio, Rhode Island, West Virginia, Washington, Indiana, Pennsylvania, Michigan and Delaware. Eight states (Connecticut, Illinois, Missouri, New York, North Dakota, California, Massachusetts, and Wisconsin) have blanket provisions with more or less general coverage of diseases arising out of or in connection with employment.

There is no question but that compensation legislation covering industrial accidents led to a rapid increase in safety activities throughout various industries of the United States. It is equally certain that the increasing legislation adding occupational diseases to the compensable list will further stimulate the development of industrial health promotion and sickness prevention.

Reporting Occupational Disease Cases

THE following 21 states now require the reporting of occupational diseases to state authorities: Alabama, Arizona, Connecticut, Georgia, Illinois, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oregon, Pennsylvania, Rhode Island, and Wisconsin.

Industrial Health Appraisal

THE appraisal idea, which has been applied in past years to city and rural health units, recently has been extended to the industrial health program, and a Sub-committee on Industrial Health Appraisal of the Committee on Administrative Practice of the American Public Health Association is now engaged in furthering this plan. A paper by E. L. Simonds and E. R. Dejon, presented before our Industrial Hygiene Section at this meeting, indicates the views of one industrial organization which for the last four years has put the *Industrial Health Appraisal Form* into use as a regular company routine. It is hoped that other industrial organizations may see the value of applying the appraisal principle to their industrial health programs in the future.

Organized Research

IN ADDITION to research in industrial hygiene now carried on by various governmental units and by many industrial organizations, there has been some recent development of special groups for organized research, including such agencies as the Air Hygiene Foundation of the Mellon Institute in Pittsburgh, and the Laboratory of Industrial Toxicology, of the DuPont Company in Wilmington, Del. In addition to these, one or two of the larger universities are now considering the development of special research institutes on industrial hygiene, with the idea of developing cooperative activities between local industries and university faculties.

Industrial Hygiene Section

THE all-inclusive interests of the Section on Industrial Hygiene of the American Public Health Association may be noted by referring to the program of the current Section meetings, which covers, among others, such subjects as "Syphilis Control in Industry," "A Symposium on the Heavy Metals," "Lead Poisoning," "The Importance and Diagnosis of the Industrial Dermatoses," and "Vaccines Against the Common Cold."

* Read before the Health Officers Seciton of the American Public Health Association at the Sixty-Sixth Annual Meeting in New York, N. Y., October, 1937; published in *American Journal of Public Health*, September, 1938.

In conclusion, attention should be called to recent significant experiments carried on by a group of research workers at the University of Toronto. Although these experiments are of a tentative and preliminary nature, it would seem that tiny traces of aluminum dust, added to the dusty, silica-filled air breathed by certain classes of miners, may some day stay the ravages of silicosis. In this study the addition of small quantities of metallic aluminum dust almost completely inhibits the solubility of silicious materials in laboratory beakers, and rabbits dusted with quartz to which less than 1% of metallic aluminum dust had been added, showed practically no lung fibrosis, which is one of the characteristic pathologic findings in silicosis; while control rabbits dusted with quartz alone showed well developed silicosis. If these preliminary experiments are subsequently confirmed by other research workers, and are found practicable from the standpoint of the prevention of human silicosis, the time may come when the funeral ritual, "Dust to dust" may be adapted as a slogan by the industrial hygienist to read, "Dust *for* dust!"

The Education of the Industrial Nurse

ONLY the general problems connected with the preparation of nurses for their work in industry will be discussed in this article.* Practical details—such as the length of the course, the actual syllabus, and the places in which the course ought to be held—should be considered *after* and not *before* these general problems have been stated.

General Preparation

THE preparation of an industrial nurse should be of a kind to fit her to make her maximum contribution to health in industry. And since health in industry means more than the prevention of disease and still more than the prevention of occupational disease in industry, any notion that the ordinary nursing school and hospital experience will really equip a nurse for an industrial nursing post should be discarded. In Britain the whole emphasis in the education of the nurse is upon disease and accidental injury than upon health. May we say then that a sound general nursing background plus a special course in public health nursing will provide the necessary educational equipment for an industrial nurse? Certainly this is not true in Britain; it is doubtful whether it is the case in America. Public health nursing education, as at present planned, does not adequately fit a nurse to make her maximum contribution to health in industry. There is, of course, much in the public health nursing course

* HOWARD E. COLLIER, M.B., CH.B., in *Public Health Nursing*, October, 1938.

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of

INDUSTRIAL PHYSICIANS and SURGEONS

Component Societies

Central States Society of Industrial Medicine & Surgery

Association for the Advancement of Industrial Medicine & Surgery

THE object of this Association shall be to foster the study and discussion of the problems peculiar to the practice of industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes and results of the medical care of employees, and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for the mutual advancement in the practice of their profession.

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which an industrial nurse should know, but there are also some things that are at present lacking.[1]

What then are the special kinds of knowledge which industrial nurses should possess?

In Britain industrial managers, when they have to fill a vacancy in the factory dispensary, often choose a calm and understanding woman with no formal nursing preparation in preference to a well qualified nurse. The manager says that his reasons for so doing are that graduate nurses seldom understand the workers, that they are not able or prepared to do much besides bind up fingers and give a dose of medicine, and that they are apt to cause trouble between workers and management.

Now we know that the reasons which the manager actually gives may only serve to hide the reasons which he does not express. We may think, for example, that the untrained person is cheaper to employ. Nevertheless if there were not substantial grounds for his criticism of the graduate nurse, he would not continue to make it.

The plain facts are as follows: The graduate nurse is eminently fitted to nurse so long as she remains within a hospital environment. The only place in industry in which such an environment can be found is the plant dispensary or hospital. The moment she is called upon to leave this familiar environment she is apt to be at a loss. The public health nurse is qualified by her general preparation for a hospital environment and by her public health education for a social environment. She is therefore much more likely to make a successful industrial nurse than her sister who is only a graduate nurse. She is familiar at least with many of the problems of health and with most of the problems of hygiene and medicine as they arise in industry. But the modern industrial environment is essentially different from either the hosptial or the home. It is a specialized environment. For that reason a specialized preparation is necessary for this type of work.

Some of the special problems in industry are:

1. Sanitation in the factory—ventilation, lighting, seating, hours of work, restrooms, toilets.

2. Health and disease in industry.

a. Industrial poisons and industrial accidents.

b. The general health of the industrial workers, and especially the health problems of women and young persons.

c. Physical and mental strains of various occupations.

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1. The National Organization for Public Health Nursing recommends a year of study in public health nursing as basic preparation for industrial nursing. It is hoped that increasingly these courses will be adapted to preparing nurses for industrial nursing. Minimum qualifications for the public health nurse in industry are now being prepared by the Executive Committee of the Industrial Nursing Section and the Education Committee of the N.O.P.H.N. They will be published in an early issue of *Public Health Nursing*. [EDITOR'S NOTE.]

d. Abnormal mental states in industry and especially the psychic disturbances of women workers.

e. The physiology of the worker--fatigue, exercise, rest, and diet.

3. The relation between industry and home health and home conditions.

4. The special medicolegal problems involving the compensation of the industrial worker.

5. Problems of the internal organization of factories such as the relations of management and workers.

6. The special sociological factors in health in industry — human relations in the industrial group, racial problems, and allied problems.

The dispensary is the one place in the plant to which, in the course of time, all of the problems of the worker are inevitably brought. If the nurse has not eyes to see, ears to hear, and a mind to comprehend the hidden meanings of the problems which are brought to her—quite apart from any ability she may acquire to relieve them—she will not be making her maximum conribution to health in industry. She will fail her employers and she will fail the workers also.

It would appear therefore that in addition to being a sound and practical nurse, she ought to have certain special knowledge, and be a special sort of person. In large measure, these two qualities are interdependent. If the nurse has the special knowledge, she will tend to be that kind of person, although the knowledge of itself will never make her a special type of individual. This is only to say that nurses are born and not made. In the last analysis, every nursing service stands or falls upon the personality as well as the preparation of individual nurses. Industrial nursing is not unique in that respect.

Special Preparation

SO WE come to the special knowledge. What is the nature of it? It may be that the following list of lectures recently given to industrial nurses in the Department of Industrial Hygiene and Medicine of the University of Birmingham will give an outline of the answer to that question:

Introduction to hygiene—personal and factory.

Planning and care of the surgery.

Factory hygiene and sanitation.

The chief occupational diseases of the local area.

The relation of the nurse to health agencies—social, medical and benevolent.

Records, statistics, and legal requirements.

Nutrition and diet of the industrial worker.

The care of women and young girls in industry.

The nurse's first aid treatment of trivial injuries and illnesses.

Psychology of the worker and the psychology of the emotions and of motives.

Social psychology in the factory.

In industries which possess a medical service, nurses who possess special

The Industrial Doctor

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preparation for industrial nursing are invaluable. In any industry which does not possess a medical service, such nurses are absolutely essential to health in industry.

Industry Combats Syphilis

A UNIQUE method of introducing to employees a program for the control of syphilis was successfully used by the Waverly Press and The Williams and Wilkins Company* in Baltimore, Marland. The plan for making Wassermann tests was interpreted to the 275 employees through an article in the June issue of *The Kalends*, the house organ of the Waverly Press. Under the caption, "No News is Good News," the July issue described the gratifying results of the program and commended fellow-employees for their response. It also announced that the company would pay the cost of future retesting, upon request of an employee. Factors which probably contributed to the success of the campaign were the careful explanation of the purpose and plan of the program; the persuasive—rather than mandatory—tone of the appeal; the promise that results would be kept confidential with the doctor; and the reassurance that a positive test would not mean dismissal if the employee cooperated in his treatment.

The two articles to employees which appeared in *The Kalends* are reprinted here:

We Join the Antisyphilis Crusade

CITY and state departments of health throughout the country are asking the aid of industry in their campaign against syphilis. In Baltimore two large companies are at present working with the city health department to this end. It is the wish of the Baltimore City Health Department as expressed to us by the Commissioner of Health, Dr. Huntington Williams, that our organization should be the third to join this crusade.

Certainly it seems logical for us to take such a step. Our close association with the medical profession, our keen interest in high individual efficiency, and our generally progressive attitude all point to the desirability of our group's lending its energies to erasing this shadow from the land. Since we printed Dr. Parran's book* most of us are familiar with the true story of syphilis: that it is plain silly to think of it as a word to be mentioned only behind a cupped hand; that it is a disease to which persons are subject, precisely as they are subject to pneumonia, regardless of any "fault" or "blame"; that affliction with syphilis is by no means invariably associated with misconduct; that such affliction is by no means necessarily a stigma. We know too that it reduces our effectiveness, that it crops up in later life to render us virtually useless and that it can, if properly and promptly treated, be cured.

The Waverly Press and The Williams and Wilkins Company therefore join forces with the Baltimore City Health Department in the battle against this scourge. Our plan is simple, effective, and cannot be objectionable to any thoughtful person. It will be under the complete control of Dr. J. A. Chatard acting as medical director for our company. Once a year Dr. Chatard will take a specimen of blood from every member of our organization. These specimens will be tested in the bureau of laboratories at the City Health Department. The results of these tests will be held in the strictest confidence between the individuals and Dr. Chatard. The management will not know them at all.

* This is a dual organization composed of the Waverly Press, a printing company, and The Williams and Wilkins Company, a publishing company. The two have an interlocking directorate and work together. This appeared in *Public Health Nursing*, November, 1938.

* PARRAN, THOMAS: Shadow on the Land. Reynal and Hitchcock, New York, 1937.

Announcing . . .

The Important New Book

MEDICOLEGAL PHASES of OCCUPATIONAL DISEASES

by

C. O. SAPPINGTON, M. D., DR. P. H.

Consulting Industrial Hygienist

HERE, in this handy volume, is the crystallization of all the medical, medicolegal, statistical and industrial information developed from the experience of the past, in form to be of utmost usefulness in the problems of the present and the future. This is essentially a book for everyday use—not to be put on the shelf for reference, but to be kept on the desk within quick reach at all times. It is a handbook—guide—manual—of constant daily importance to physician, lawyer, hygienist, engineer, safety director, nurse, claim agent, in fact everyone interested in any phase of the occupational disease picture. Annotated to most of the significant literature, it brings to all of it the means of adaptability and orientation. The author is well known in the field of his book as having lived and worked for many years in the midst of the developments he writes about. The following table of contents is a preview of the subject matter.

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5⅞" x 8¾" in size; handsomely bound; illustrated; completely and carefully indexed; ready for delivery about February 15, 1939. Price $2.75, postage prepaid.

INDUSTRIAL HEALTH BOOK COMPANY

330 South Wells Street, Chicago, Illinois.

Anyone whose test is positive may obtain treatment from his or her family physician, or, if this cannot be afforded, from the free clinic operated by the health department, which is prepared to treat with skill equal to any. Dr. Chatard will be kept informed by the family physician or the clinic as to the regularity and progress of the treatments. Only if a person ceases treatment before the end of the course of treatments has been reached, will Dr. Chatard report to the management of our company. Our policy is to deny no one employment because he has a positive test, so long as he continues proper treatment.

This all seems fair enough. We are not interested in prying into people's personal affairs. We respect the condition of confidence between patient and physician. We do not choose, however, to assume responsibility for anyone so short-sighted as to refuse needed treatment. Since our policy is to give employees steady, permanent emp'oyment up to and often past the normal retirement age, we have a keen interest in their health. An incompletely cured case of syphilis can and usually does crop up in middle or old age as heart trouble, mind trouble, and in many other ways affecting ability and productivity. Hence our insistence on treatment that is complete.

New employees will be tested in the same fashion as part of our employement routine. But no one otherwise qualified will be denied a job with us because of a positive test so long as adequate and uninterrupted treatment is taken.

To summarize our plan:

1. Entire program under the direction of our friend and neighbor, Dr. J. A. Chatard.
2. Test for all new employees.
3. Test for *every* member of our organization once a year.
4. Results of tests known only to Dr. Chatard and the individuals.
5. Treatment by family physician to be paid by the individual, or by free clinic at patient's choice.
6. Continuity of employment affected *only* if treatments are refused or stopped prematurely.

In the near future each person will be notified of the time that he or she is to report for the taking of a blood specimen. Dr. Chatard will use our conference room for this purpose. Only one person will be taken at a time. As most of us know, the taking of a blood specimen is a very quick and painless procedure that need in no way be dreaded.

No News Is Good News

OUR company as the distinction of being the first in Baltimore to do a 100% job in the sero-diagnostic laboratory testing for syphilis. Three other companies are now testing new employees only but our examination recently completed included every one of the 270 members of the dual organization. Dr. Huntington Williams, Commissioner of Health of the Baltimore City Health Department, expresses himself as being very much pleased with this showing.

We can well be proud of the results of this test. First there is a certain amount of satisfaction in being pioneers in a worth while cause. Then the fine cooperation given by the group is something that not every plant could boast of. This cooperative spirit was solely responsible for making the test 100% and it is appreciated. But best of all was the clean bill of health which the examination gave us—less than 2% positive tests in 270 people. That is something to really shout about when statistics show that from 5 to 10% positives have been found in other groups.

Needless to say, those of us who did not hear from Dr. Chatard had a negative test and those who did hear from him are known only to Dr. Chatard and will continue on this basis so long as they continue adequate treatment.

Our next thought should be for the future. We have made a grand start and want to hold the ground that we have gained. As originally planned, all new employees will be tested as a routine matter. None in a noninfecious condition even though they have a plus test will be denied employment provided they take and continue proper treatment. Both Dr. Williams and Dr. Chatard question the need of an annual examination for all regular members of the organization. They feel that the cost and time required is not justified by the findings and furthermore that such an examination does not accomplish all that we are after.

The ideal condition of course is to keep free of syphilis but the next best thing is for anyone who is the least bit in doubt about his or her condition to have a test made and if indicated to start treatment at once. When this is done a cure is virtually assured. When precious time is lost a cure is not as certain. This explains why the annual examination falls down. If such an examination is depended on it is possible to lose 364 valuable days and reduce the chance of cure proportionately.

We don't want to get neurotic on the subject and imagine all sorts of terrible things that don't exist but we do want to keep the danger of syphilis in mind and have a test made if we think that there is a chance of infection. This is so fundamentally important to the success of the whole program that the company will stand the cost of the tests. Anyone wishing at any time to make such a checkup need only apply to Dr. Chatard.

If this is done by everyone consistently, instead of our group's being 1.8% positive we will eventually approach zero as a limit; and if all other industrial groups would do the same thing syphilis would be virtually eliminated from this country. And that is worth working for.

What It Is Opposed To!

ORGANIZED medicine has never objected to private health insurance.* It is opposed to compulsory sickness insurance because the latter imposes lay-political control over medical practice, substitutes quantity for quality in medical care, and nullified the incentives and opportunities for private medical research and graduate medical study. It opposes voluntary health insurance under government control because this has always proven a precursor of compulsory insurance.

"Let us state once more that the medical profession does not object to social change *per se* or to government aid to the needy. It is opposed to the reckless abandonment of a system which has made the American people the healthiest in the world, for a bureaucratic rule which has nowhere yielded comparable results."

Ocupational Disease Coverage — 1938 —

I. "Blanket" Coverage 7
Calif.; Conn.; Ill.; Ind.; Mo.; N. D.; Wis.

II. "Schedule" Coverage 10
Del.; Mich.; Minn.; N. J.; N. Y.; N. C.; Ohio; Penna.; R. I.; Wash.

III. Special Provisions 4
Ky.; Mass.; Nebr.; West Va.

IV. No Coverage 27
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Note: These states, with Del., Minn., N. J., and R. I., make no provisions for coverage for compensation because of disability arising from dust diseases.

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* *Wisconsin M. J.*

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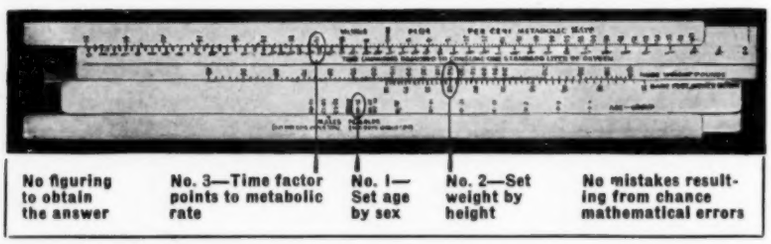
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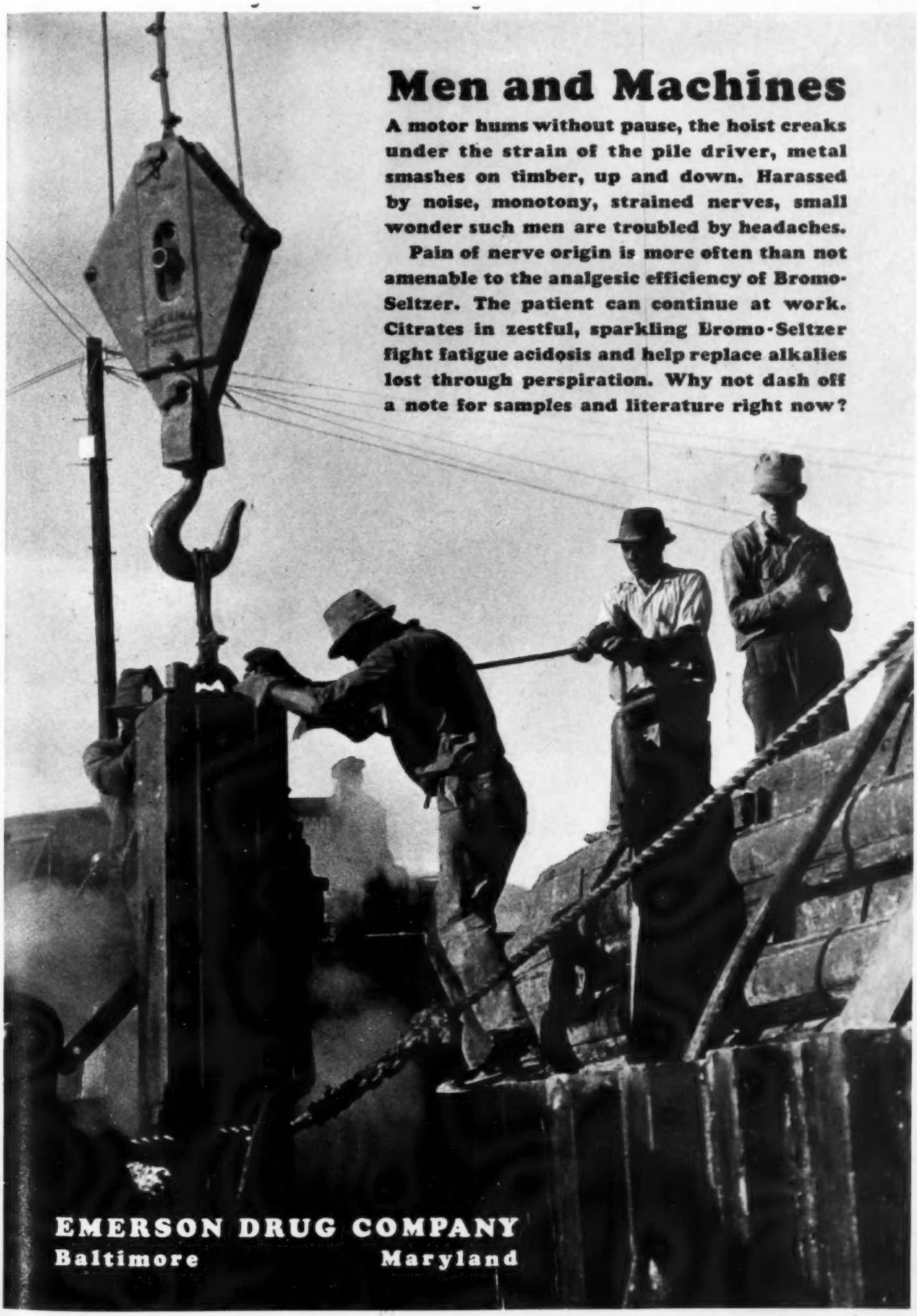
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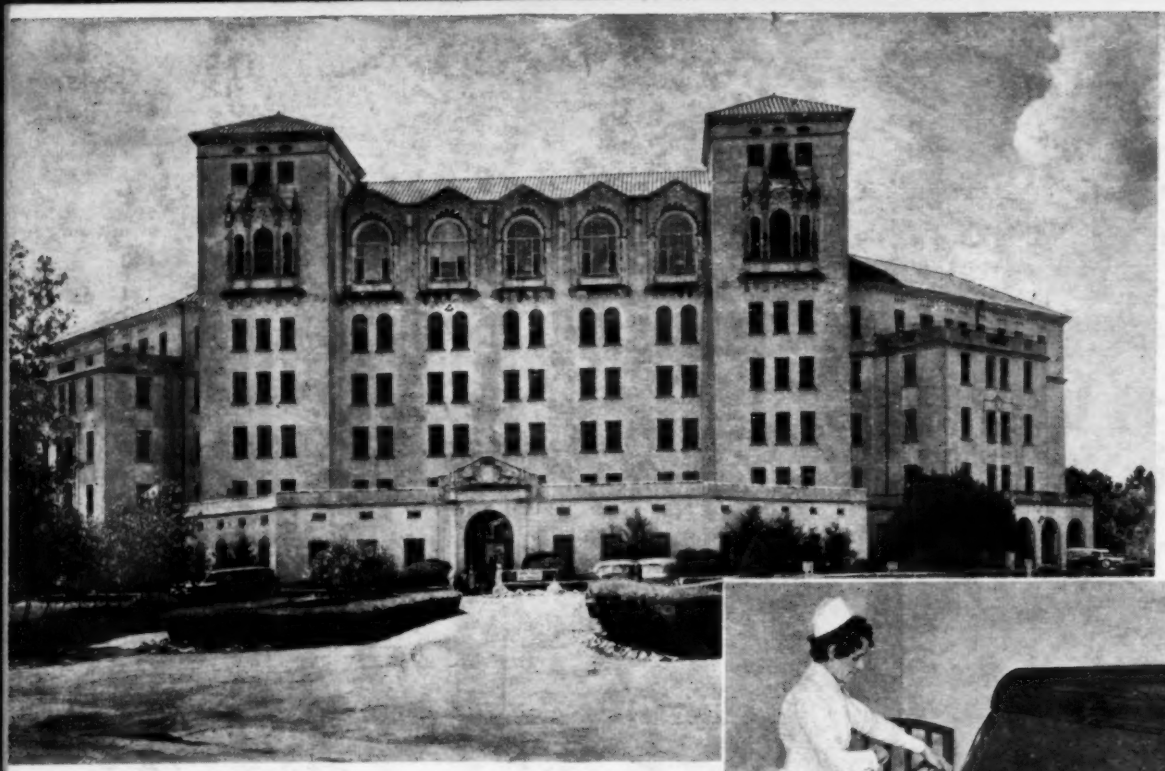

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